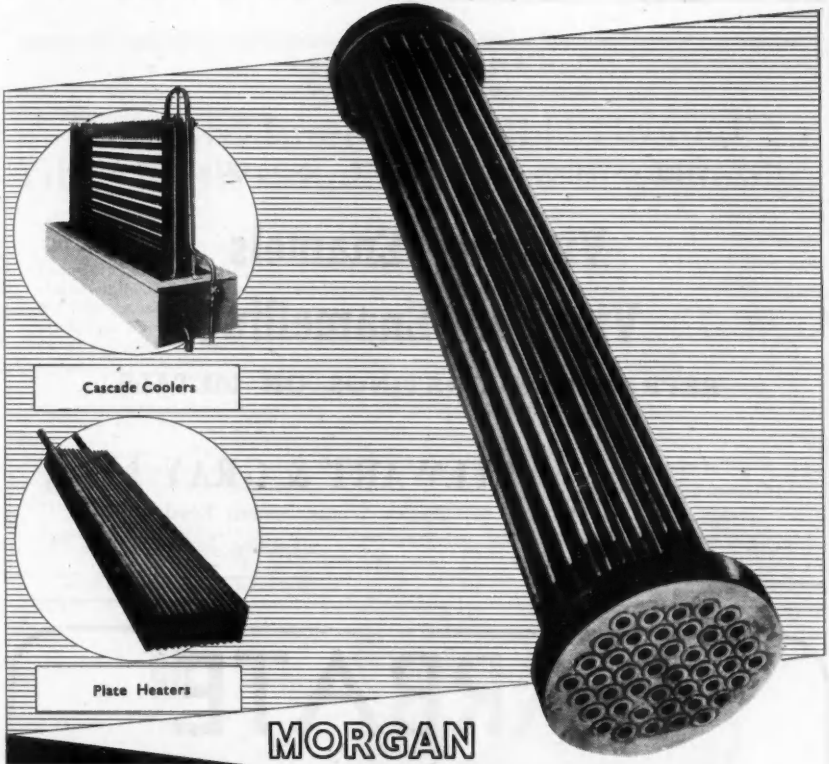
The Chemical Age

VOL. LXVI 22 MARCH 1952 No 1706

INDEX TO ADVERTISERS IN THIS ISSUE

	Page
Airey, Robert, & Sons, Ltd.	xix
Bamag, Ltd.	459
British Acheson Electrodes, Ltd.	vi
British Iron & Steel Federation	xi
Brough, E. A., & Co., Ltd.	xii
Cole & Wilson, Ltd.	xviii
Cruickshank, R., Ltd.	Cover ii
Classified Advertisements	xvi, xvii, xviii
Electrothermal Engineering, Ltd	xix
Farwig, J. F., & Co., Ltd.	Cover iii
Gas Council	xv
Guest Industrials, Ltd.	x, xix
Girling, S., & Sons (Coopers), Ltd.	Front Cover
Haughton's Metallic Co., Ltd.	xx
Innes, J. K., & Co., Ltd.	460
Isopad, Ltd.	xiii
Jenkins, Robert, & Co., Ltd.	xiv
Jobling, James A., & Co., Ltd.	vii
Kestner Evaporator & Eng. Co., Ltd.	xii, xx
Key Engineering Co., Ltd.	Cover ii
Leigh & Sons Metal Works	xx
Lord, John L.	Cover iv
Metropolitan-Vickers Electrical Co. Ltd.	Cover iv
Metway Electrical Industries, Ltd.	iv
Mirrlees Watson Co., Ltd.	x
Mitchell, L. A., Ltd.	xx
Monsanto Chemicals, Ltd.	viii, ix
Morgan Crucible Co., Ltd.	v
Negretti & Zambra, Ltd	xix
Nu-Swift, Ltd.	xviii
Power Gas Corporation, Ltd.	i
Propane Co., Ltd.	Cover ii
Simon, Richard & Sons, Ltd.	Cover iii
Steele & Cowlishaw, Ltd.	xx
Stewart & Gray, Ltd.	vi
Thorn, J., & Sons, Ltd.	iv
Unifloc, Ltd.	xiv
Wallis, Charles, & Sons (Sacks), Ltd.	xx
Ward, Thos. W., Ltd.	ii
Wilkinson, James, & Son, Ltd.	iii



Cascade Coolers

Plate Heaters

MORGAN CARBINERT

FOR THE CHEMICAL AND PROCESS ENGINEER

CARBINERT (Impervious Graphite) is a robust material having a high rate of heat transfer and exceptional resistance to acid attack. This unique combination of properties is found in CARBINERT—a material whose proved efficiency in the chemical and process industries offers vast potentialities. The Bundle Heat Exchanger illustrated above has an internal area of 60 sq. ft. and an external area of 86 sq. ft. The overall heat transfer coefficient, depending on rate of flow, is from 250-350 B.Th.U./hr/sq. ft./° F. for the conditions of condensing steam liquid.

For further details on applications write for Booklet P.11.

THE MORGAN CRUCIBLE COMPANY LTD

BATTERSEA CHURCH ROAD · LONDON · S.W.11

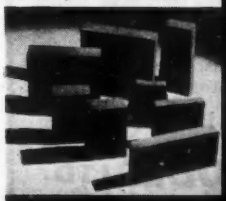
TELEPHONE · BATTERSEA 8822 · TELEGRAMS · CRUCIBLE, SOUPHONE, LONDON

CH 104

Carblox Tiles are ideal for lining all types of Chemical Plant.

Carblox is made by one of our associated Companies.

CARBLOX LTD.,
STORRS BRIDGE,
LOXLEY, Nr. SHEFFIELD



The
Chemical Age

Established 1919
The Weekly Journal of Chemical Engineering and Industrial Chemistry

BOUVERIE HOUSE 154 FLEET STREET LONDON E.C.4
Telegrams: ALLANGAS FLEET LONDON · Telephone: CENTRAL 3212 (26 lines)

Volume LXVI 22 March 1952 Number 1706

A New Chapter?

TWENTY years ago the text-books, made no mention of fluorocarbons, even the more advanced species; in twenty years' time this group of compounds may well form the most important item in the section devoted to that difficult and violent element, fluorine. In some degree Shakespeare's title, 'The Taming of the Shrew,' might be appropriately applied to the story of fluorocarbon compounds. For here are two reactive elements—one of them the most chemically reactive gas yet known—and the early history of attempts to make them combine, like the history of isolating fluorine as an element, has been arrayed with explosions; yet when fluorocarbons are produced many of them display a remarkable inertia, a chemical and thermal stability that is quite remarkable. Carbon is probably the most important 'structural' element. The infinite diversity of molecular patterns that can be centred around carbon has given, and is still giving us, fuels, fibres, foods, oils, plastics, and the rest. But the stability of inertia is rarely passed by carbon compounds and then only to a relative extent. For greater stability allied with similar physical properties we have turned to the comparable compounds of silicon, the family of silicones. It is possible that the fluorocarbons will eventually offer much more than the silicones. The molecule-building flexibility of carbon is not lost and the replacement of hydrogen atoms by fluorine appears to set up a substantial shield against the reactivity of carbon atoms. It seems safe to predict that many more fluorocarbons will be preparable than the silicon analogues of carbon compounds, and that quite often the fluorocarbon will possess the greater stability.

Fluorocarbons passed out of the curiosity class during the war. This first major stage in their history is not widely known for it was long concealed for security reasons. In a number of research centres priority was secretly given to fluorocarbon projects and in the early 'forties the security name of 'Joe's stuff' was given to these substances. Was this a token of the late President Roosevelt's faith in high-level diplomacy on the basis of Christian names? Perhaps some other 'Joe' was referred to? But whether Joe of the East or West, the Oak Ridge atomic bomb project rested at one stage upon the development of fluorocarbons. An urgent need arose for some substance that could be mixed with uranium hexafluoride yet never react with it. Such a substance had to be exceedingly stable and to possess a boiling point and molecular weight not far

removed from those of uranium hexafluoride. It is said that a minute sample—only two cubic centimetres in volume—left over from pre-war fluorocarbon research provided the solution for this difficult chemical problem. Thereafter fluorocarbon research became a task of military urgency. In the U-235 separation plant a range of fluorocarbon compounds was required—to serve as lubricants, packing materials, gasket material, etc. But fluorocarbon production was all that mattered; costs of production were a minor consideration set against the vast total cost of the atomic bomb venture. The fluorocarbons were mainly produced by the direct interaction of carbon and fluorine, the explosiveness and uncertainty of these methods having been removed or minimised by the introduction of catalysts. It is doubtful, however, whether any significant industrial or commercial use of the unique properties of fluorocarbons can ever be developed if fluorocarbon production has to be based upon such costly methods.

In the last quarter of 1951 what in the future may be looked back upon as the second major stage in fluorocarbon history was initiated in Minnesota. A cold electrochemical process for fluorocarbon production started commercial-scale production after several years' research and pilot-scale development. For this process elementary fluorine is not required; the source of this element is anhydrous hydrogen fluoride. The reaction vessel is an electrochemical cell. To this cell is fed a mixture of hydrogen fluoride and the analogous carbon compound. The flow of electricity causes the fluorine to take the place of the hydrogen in the organic compound. Hydrogen, released from both the organic compound and the hydrogen fluoride, is removed in ordinary gaseous form. It is claimed that this process has brought fluorocarbon synthesis within commercial reach.

Not all the fluorocarbons are unreactive. Unsaturated compounds can be polymerised. It has already been shown that an unsaturated perfluoro acid can be polymerised to make a film-material that has unrivalled durability, is non-inflammable, and allows the passage of ultra-violet light. Inert fluorocarbons have shown superior stability to silicones as lubricants. Sealed car engines with permanent fluorocarbon lubricants are feasible. Car tyres made from a fluorocarbon-based rubber might have a life as long as that of the car itself. Fluorocarbon liquids could permanently occupy the car radiator. These large-scale possibilities may prove to be economic day-dreams. The future of fluorocarbons may be more shrewdly predicted in terms of special uses in which the unusual physical and chemical properties of this new class of compounds are utilised in other manufacturing processes that are at present impracticable. It is not an exaggeration to say that yet another new chapter in applied chemistry has been opened.

On Other Pages

Professor N. V. Sidgwick . . 432
Fuel, Heat and Power . . 433
World Demand for Instruments . . 434
The Control of Gas Separation Plants 435
Plastics and Building . . 438
Internal Electrolytic Titration . . 439
Volumetric Glassware (BIS Standard) 440
Proton-Free Inorganic Solvo Systems . 441
Improved Ethylene Procedure . . 443
Importance of Plant Engineers . . 446
Analytical Chemistry of Potassium (Part 1) . . 447
Chemist's Bookshelf . . 451
Overseas News Items . . . 453
Home News Items . . 454
French Export Gains . . 455
Publications and Announcements . . 456
Next Week's Events . . 457
Market Reports . . 458
Law and Company News . . 460

The annual subscription to THE CHEMICAL AGE is 35s. Single copies, 9d.; post paid, 1s.; SCOTTISH OFFICE: 116 Hope Street, Glasgow (Central 3954/5). MIDLANDS OFFICE: Daimler House, Paradise Street, Birmingham (Midland 0784-5). THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers, Limited.

Notes & Comments

Chemical 'Smells'

A STEP towards the control of industrial odours is reported to have been taken in the United States. The Franklin Institute of Philadelphia has designed testing equipment that enables the odour-producing chemicals in the air to be collected and concentrated. The principal unit in this new kind of equipment appears to be a condenser that uses liquid nitrogen as refrigerant. The noxious air is cooled to a temperature of 300° F. below zero. The liquid thus produced is then analysed, using an infra-red spectrometer. Results are presumably to be checked with a schedule previously based upon known quantities of the common malodorous chemicals that cause atmospheric pollution. It is suggested that the availability of testing equipment of this nature will make anti-odour pollution legislation possible. This is surely a dubious claim. Ingenious though the new apparatus may be, it is no more than another means for sampling and quantity-assessing trace amounts of impurities in air. It does not measure 'smell' and if there are to be enactments to prevent objectionable odours being added to the air it seems dangerous to base them upon assumptions that certain trace-amounts of specific substances cause certain degrees of 'smell' nuisance. The property of odour is still very incompletely understood though no chemist would deny that minute amounts of some substances can cause considerable public nuisance. We are closer to the scientific measurement of that other indeterminate nuisance, noise, than we are to the measurement of odours.

Animal Tests for Toxicity

A PAPER read by Dr. Frank Princi in Ohio last December (*Agricultural Chemicals*, 1952, **7**, 1, 44) delivered some hard and timely blows to the all-too-readily accepted principle of testing a substance's toxicity by animal tests. To begin with there is insufficient knowledge about detailed normality in animals. Also, there have been some serious breakdowns in the loose hypothesis that what is toxic to animals is likely to be toxic to humans. Beryllium's toxicity was entirely missed in animal tests; poisoning by the beryllium ion first revealed itself in human cases. More recently there is the outstanding case of 'Agene' with its toxic effects upon dogs; yet despite the amount of 'Agene' that has been consumed no parallel developments have yet been found with humans. Rats can live healthily with considerable amounts of Welsh coal in their lungs; unfortunately the same capacity is not possessed by miners. Animal studies may well give a sound answer when the toxicity of a powerful dose of a strong poison is being examined, but they cannot give anything better than vague guidance in more marginal cases. Should so crude a test be relied upon for assessing the toxic risks of insecticide or fungicide residues on crops?

Clinical Evidence Available

IF better methods of testing are not available, the laboratory animal test must still prevail. But, as Dr. Princi pointed out, evidence for the direct effects of these chemicals upon humans is readily to hand. In the factories that manufacture them and in the organisations that contract-spray them hundreds of workers are exposed to a high risk of absorption and ingestion. Despite all precautions there will be some carelessness in handling and the consequent cases of poisoning, especially those due to an extremely high intake, provide far better guidance than comparative animal tests. When 384 cases of DDT poisoning are studied, it is found that recovery in human beings is far quicker than would be suggested by animal tests. The tendency of DDT to accumulate in fat appears to be much less hazardous in humans. All this clinical evidence deals with actual human cases of high DDT absorption. Can it be ignored in trying to assess the dangers of trace absorption from spray residues?

OBITUARY

Professor N. V. Sidgwick

Passing of an Eminent Chemist

THE death took place on Saturday, 15 March, at a nursing home in Oxford, of PROFESSOR NEVIL VINCENT SIDGWICK, C.B.E., F.R.S., at the age of 78.

Professor Sidgwick, who was born on 8 May, 1873, was the eldest son of William Carr Sidgwick, a Fellow of Merton College. He was educated at Rugby School, and Christ Church, Oxford. After first specialising in the classics, he turned his attention to science. He spent three years studying chemistry and took a first class in Finals in 1895 and then decided to read Greats, when after a further two years of work he took another first class.

Studied under Ostwald

Following his final examination Sidgwick acted for a time as a demonstrator under Harcourt before going to Leipzig to study under Ostwald. After a brief visit to England, he returned to Germany to carry out research under Professor Peschmann at Tübingen. In 1901 he was awarded the degree of Dr. of Philosophy with the highest honours.

Sidgwick returned to Oxford, became a Fellow of Lincoln College and University Reader in Chemistry. For many years he quietly pursued research and teaching. He was primarily interested in problems of molecular structure, and his early experimental work dealt with tautomerism and the collection of data bearing on the vapour pressures, boiling points and solubilities of isomerides.

Organic compounds of nitrogen received particular attention from Sidgwick and in 1910 he published 'Organic Chemistry of Nitrogen' which was considered the most admirable English text book of its day, and is still, in its revised form, a standard text book.

Despite its success Sidgwick did not really become prominent in scientific affairs until after the 1914-18 war.

In 1920 he started to apply the Rutherford-Bohr nuclear theory of the atom to problems of chemistry. He demonstrated the existence of co-ordination compounds of the alkali metals and the co-ordinating properties of the hydrogen atom and was the first to develop the theory of the co-ordinated covalent link. The result of his seven years' work was the appearance in 1927 of 'The Electronic Theory of Valency,' which placed him in the front rank of chemists.

Much valuable work was done by Sidgwick in extending the co-operation between chemistry and physics and the school of physical chemistry which has arisen in Oxford owes much to him.

Among his many positions and awards Sidgwick was chairman of the publications committee of the Chemical Society and its president from 1935-37; president of the Faraday Society; he was elected a Fellow of the Royal Society in 1922, was one of its vice-presidents from 1931-33 and received a Royal Medal in 1937. In 1945 he was awarded the Longstaff Medal of the Chemical Society.

Probably there was no British scientist more intimately known in America than Sidgwick. In 1931 he was invited to deliver the George Baker Lectures in Cornell University which were published two years later under the title of 'The Covalent Link in Chemistry.' His stay of four months at Cornell made him very fond of the country and its people, besides endearing him to them and he frequently returned and travelled widely throughout the U.S.A.

His last and perhaps greatest book was 'The Chemical Elements,' published in 1950, in which are stored the fruits of a long life of study and research.

Executives Return

Back from a four-weeks' trip to South Africa to arrange for the manufacture of Innoxa cosmetics in the Union are Mr. A. Alberman, the company's managing director, and Mr. A. S. Hull, chief chemist. 'In view of the import restrictions on British goods we have decided to manufacture our cosmetics in South Africa in co-operation with our agents, Messrs. Fassett & Johnson' Mr. Alberman said on his return.

Fuel, Heat & Power Auditing

Value of Mobile Testing Units

SUCCESS in bringing the laboratory to the workshop has been amply demonstrated by the development and placing on a permanent basis of the mobile testing units of the Fuel Efficiency Branch of the Ministry of Fuel and Power.

Starting with one unit, an ex-radar van refitted and equipped with an extensive range of indicating and recording instruments, this was soon augmented by three others to deal with the requirements of large firms, and later by 12 light units for medium-sized and smaller concerns (THE CHEMICAL AGE, **59**, 781; **62**, 5; and **64**, 583).

An account of the work of these mobile testing units and the experience gained in practice since their inauguration a little over three years ago was given by L. Clegg and J. Price Walters (Fuel Efficiency Branch, Ministry of Fuel and Power, London), in a paper delivered to the Institute of Fuel at a meeting in London on Tuesday, 18 March. It was emphasised that the fuel efficiency advisory service of the Ministry of Fuel and Power should be regarded as an adjunct, and not an alternative, to the services of the specialist consultants.

In order to achieve the best fuel efficiency in any factory it was necessary to prepare a complete heat balance, showing on the one side, the total potential energy purchased in the form of fuel or electricity, and on the other side, the quantity of heat and power generated and/or distributed to each department and/or various processes. In other words, to audit the use of fuel and power.

This required accurate measurements which, in turn, necessitated the use of a wide range of instruments such as was rarely found in industrial establishments. Each of the mobile units and the headquarters' organisation supporting it was equipped to do this.

Conference with Management

First essential was a conference with the management to discuss the function of the factory to be investigated, its products, the raw materials used, physical layout and processes involved, including the space-heating of buildings. Next a complete survey was made of all types of plant being investigated. The list might include gas producers, furnaces, kilns, driers vats, evaporators, water-storage systems, refrigeration plant, all types of prime movers, space-heating, air conditioning and electrical installations.

Usually the survey began with a boiler and power-plant trial, run continuously for a full working week under normal operating conditions or for the period necessary to include all variations of load.

Observations Analysed

When the survey was completed, all the observations were analysed and tabulated at headquarters prior to preparation of the report. Existing operation and test results were recorded and supported by relevant drawings and graphs. These might suggest that changes in the method of operation would improve material throughput and/or uniformity of product, besides giving financial benefits and improved fuel efficiency. In such cases the necessary supporting calculations and diagrams were given.

The report normally began with a summary intended for the management and was followed up by more detailed observations, calculations, conclusions and recommendations intended for the technical officials of the firm and their consultants.

Function of the fuel efficiency advisory service was to stimulate the interest of all concerned, particularly management, in fuel efficiency, to present the facts and to draw attention to extravagant heat-using processes, sources of avoidable heat loss and scope for economy.

Recommendations might include ways and means of achieving the savings, but the service did not include redesign of plant, design of new plant which might be recommended, preparation of estimates or specific advice on the make of plant or equipment to be installed.

Work by the Ministry's fuel engineers should be followed up by prompt and effective action on the part of the management of the firm. The work required might well be within the capacity of the technical staff of the firm, but in some cases it was desirable to call in the services of specialised consultants.

The number of surveys carried out from

the inauguration of the service in 1949 to 31 December, 1951, was 125. They varied in duration from four to six weeks. The savings proved to be attainable varied from 3.6 to 56 per cent, the overall weighted average being 20.8 per cent.

In some case the anticipated savings had actually been achieved or even exceeded by carrying out the recommendations made in the survey reports. But such savings were not always apparent in the fuel-consumption figures because in many cases the effect had been that production was increased without adding to the fuel consumption of the factory.

Types of factories surveyed to date included: Chemical manufacture, china clay, rayon, wool and other textiles, cement, paper mills, diatomaceous earth, tobacco, sheet-metal works, steelworks, building board, cables, malt extract, animal by-products, cellulose film, jointing material, china and pottery, tar-distillers, heavy and light engineering, glass manufacture, soap, sugar, rubber, tanneries and leather cloth.

To conclude their paper the authors gave an example to show what was involved in a complete survey. Bearing in mind the fact that Ministry survey reports were confidential documents, for purposes of their illustration they combined actual surveys in technically allied industries, the figures and other facts quoted being based on those actually observed in practice. The industries selected were viscose yarn and film manufacture, as in these cases steam, power, air-conditioning and hot-water supplies were of major importance.

Demand for Instruments

Problem of Raw Material Shortages

DIFFICULTIES in meeting the demands for its instruments were referred to by Mr. P. E. Negretti, chairman, in his review of the year ended 30 September, 1951, in the sixth annual report of Negretti & Zambra, Ltd., to be submitted at the annual general meeting in London on 1 April.

Chief problems had been the shortage of raw materials and scarcity of skilled labour. The former first became apparent in the latter half of 1949 and had grown steadily worse. The housing shortage had prevented full advantage being taken of the production facilities at Aylesbury. However 16 houses had been completed during the period under review, and a further 30 were well on the way, so that the position should soon show signs of improving.

Value of orders received during the year, after making due allowance for any price increase which had taken place, was 41 per cent higher than during the previous year and 13 per cent higher than the year's output. Orders received during the first two months of the present year exceeded those received during the same period of last year by 20 per cent. The rearmament programme had, of course, had some effect on these results, but that was not the only or principal reason.

In previous reports the importance the company attached to development had often been stressed. This was confirmed by the demands experienced for its instruments at the present time, as during the past few years its range had been increased by developing new and improved types.

Increased Exports

As regards export, the volume of business with overseas customers had increased by 44.3 per cent over the previous year's figures, while the value of the instruments supplied to firms in this country for use with plant being sent overseas had also increased during the year.

The company in South Africa had in its first complete year's trading done a very satisfactory volume of business, and had made a valuable contribution to the increase in our overseas trade, largely due to the establishment of service and repair facilities in Johannesburg. Future prospects were good.

During the year there had been an opportunity to discuss with Australian colleagues the future arrangements of business in their country. It was felt that mutual benefits would result.

In Holland, as carrying on business through an agent presented certain difficulties, it had been decided to establish a branch in that country. This had been done and there was every indication that the business results in the future would be satisfactory.

Volume of business had increased and profit before taxation had risen from £163,114 to £199,373.

Control of Gas Separation Plants

Principles & Practice with Constant & Variable Feed

LOW temperature gas separation plant control was the subject of a paper by M. Ruhemann, Ph.D., M.I.Chem.E., of Petrocarbon Ltd., Manchester, read to a joint meeting of the Low Temperature Group of the Physical Society and the Institution of Chemical Engineers in London on 11 March. The following is an abstract of the paper:—

In a gas separation plant, unlike other continuously operating plants, there is only one raw material—the mixture that is to be separated. If this is air, the plant is said to operate with constant feed. If it is 'cracker gas' or other industrial gas coming from a plant, it may have a very variable content, and the separation plant is then said to operate with variable feed. To run a plant as it is designed to run means the control of certain variables such as temperature, pressure, rate of flow and liquid level either to constant values or within narrow limits. With variable feed these variables are likely to alter with the state of the feed, and be controlled as functions of it.

The control of these principal variables is best done, with all but temperature, by regulating the rate of flow of materials through the plant. Thus pressure can be altered by throttling or opening a valve to withdraw gas from the vessel; liquid level can be adjusted by the supply or discharge of liquid through a valve. Temperature can be varied by supplying or removing heat, which can be regulated by a valve controlling the supply of heating or cooling media. Thus all control can be accomplished through valves.

Requisite Number of Valves

The number of valves needed to fulfil the design conditions of a plant cannot therefore exceed the number of streams, although it may be less. The main problems of plant control are:

(1) How many controllable streams are there in the plant?

(2) What are the design conditions?

(3) Which design condition shall be used to control which stream?

An example of a unit with three controllable streams is the partial evaporator, where a liquid is to be partially separated into vapour rich in one component (say, ethane) and a liquid rich in the other (say, butane). There will be three variables—temperature, pressure and liquid level, and three controllable streams besides the uncontrollable feed, which may vary in considerable degree—the vapour outflow, the liquid outflow, and the flow of steam. To maintain the conditions it should be adequate to control valves regulating these three streams, and so, if the plant is to be automatically controlled, obviously three controllers will be required, one actuated by temperature, one by pressure, and one by the liquid level. It is now necessary to allocate these controllers to the control valves.

Wide Range of Effects

Fairly obviously in this case, the first will control the steam valve, the second the vapour outlet valve, and the third the liquid outlet valve. Other cases will not be so obvious, however, because besides its primary effect, the opening or throttling of a valve has secondary and even tertiary effects. Thus the opening of the vapour outlet valve will not only lower the pressure, but the temperature as well. It will also, to some extent, cause the liquid level to fall as more liquid evaporates. The best-controlled systems are those where the primary effects are used for control, and the arrangement whereby this is ensured must be worked out individually from the number of combinations of valves and controllers possible in the particular plant being considered. To judge the system produced it is useful to assume the plant to be running in the steady state and then to imagine a disturbance to occur.

In a plant with variable feed, the most informative disturbance is a change in the state of the feed. If the composition of the feed remains constant but the rate of flow increases there will be two immediate effects: the liquid level will tend to rise and the temperature will tend to fall. As a result of increase in amount of flash gas, the pressure will also tend to rise. The result will be that all three controlled valves will open up simultaneously. New equilibrium

positions will be established and the conditions will be restored. A decrease in feed flow-rate will have the opposite effect. If the rate of flow remains unchanged but the feed becomes richer in ethane the temperature will tend to fall, since at the specified pressure a mixture rich in ethane will boil at a lower temperature than a mixture richer in butane. The steam valve will therefore open up, more vapour will be formed, and the vapour outlet valve will open to avoid an increase in pressure. Simultaneously the liquid level will tend to fall and the liquid outlet will consequently be throttled. The resulting new equilibrium condition will be such that less liquid and more gaseous product will be made in accordance with the changed feed composition. A change in the opposite direction will have the corresponding result.

Independent of Feed Variations

It is clear that in this particular case the design conditions are independent of the feed variations. The values specified for temperature, pressure and liquid level are therefore constants, and it is thus not necessary to adjust these values to accommodate any variation in the feed conditions.

The partial evaporator which has just been discussed is the most primitive form of distillation plant. Before considering the control of a fully developed fractionating column equipped with a re-boiler and a reflux condenser, it will be useful to consider briefly the 'stripping column', a unit still frequently employed in small air separation plants.

The stripping column is a normal distillation column with a re-boiler but without a reflux condenser. The liquid mixture is fed to the top of the column, and the least volatile component is withdrawn from the sump either as a liquid or a vapour of high purity. The gaseous overhead product is not pure, and contains at least as high a concentration of the less volatile components as is in equilibrium with the liquid feed.

Suppose that the same mixture of ethane and butane considered previously is fed to the top of a stripping column. A pressure of 7 atmospheres has been chosen, and a liquid level is to be established in the sump high enough to cover the re-boiler coil but not so high as to cause entrainment on to the bottom plate. The control problem is in many ways similar to that of the partial evaporator. A level controller will be installed actuating the offtake of the bottoms product, and a pressure controller will regulate the valve withdrawing the overhead. Since there will be a pressure differential along the column due to the resistance of the plates, and since this differential will vary with the load, the pressure can be held constant only at one point. It is reasonable to install the pressure controller at the top of the column near the overhead take-off which it controls. The pressure at other points of the column will then be a dependent variable, and as such uncontrollable.

The principal difference in control between the partial evaporator and the single column lies in the temperature control of the steam to re-boiler. As the column is to deliver a pure bottoms product the temperature in the re-boiler itself cannot be higher than the boiling point of pure butane at the chosen pressure. This, however, is the temperature at which the re-boiler would have to be held. Such a controller would control in one direction only and would be insensitive, because a considerable contamination of the bottoms product would not lead to a significant drop in temperature. If the temperature controller were installed at the top of the column, it would similarly have to control at the lowest possible overhead temperature.

It is therefore usual to install the temperature controller at an intermediate point on the column, and to determine empirically or by calculation the correct temperature at which it shall control. This has the twofold advantage of permitting control from both directions around the control point, and of increasing the sensitivity.

Point of Installation

The point of installation is so chosen that a slight alteration in composition leads to the greatest possible change in temperature. The control point is taken as the temperature on a certain plate which will just lead to a pure bottoms product and at the same time reduce to a practical minimum the concentration of heavier products in the overhead. If the temperature on the plate drops below the control point, the bottoms product will tend to become impure. The controller then increases the flow of steam to the re-boiler, the boil-up is increased and the temperature on the control plate is

restored. Conversely, if the temperature rises above the control point, the more heavy component is lost to the overhead and the control valve reduces the flow of steam, and hence the boil-up.

With the controllers installed in this way a further difference becomes apparent between the control of the stripping column and of the partial evaporator. In the latter case it was found that the design conditions were constant and independent of the feed conditions. With the stripping column this is still true of the level controller and the pressure controller, if this is installed at the top of the column, but not of the temperature controller if the impulse is taken from an intermediate plate. If the feed to the column is increased at constant composition, the pressure differential through the column will rise. The pressure at the control point will therefore be higher than before, and the temperature will have to be raised to maintain the required re-boil ratio.

Negligible Effect

This effect may be negligible if the pressure differential is small. But if the composition of the feed changes, e.g., if the ethane content of the butane-ethane mixture increases, and if pure butane is still to be withdrawn from the sump, the temperature distribution in the column will no longer be the same. There will be a temperature drop throughout the column varying from zero at the sump to a maximum at the top of the column. In particular the correct temperature at the control point will be lower than it was before, and it will therefore be necessary to re-set the control point temperature in conformity with the state of the feed. There are several ways in which this can be done manually or automatically, but they are all complicated, and if the feed contains more than two variable components an automatic re-set may be impossible and it may then be necessary to change the method of control.

The complete fractioning column has a reflux condenser as well as a re-boiler. The feed is introduced on to an intermediate plate, as a vapour or a liquid or a mixture of the two. If the feed contains only two components, bottoms and overhead product can both be substantially pure. In considering the simple case in which the overhead is a vapour and the bottoms product is in liquid form, it will also be assumed that the re-boiler and the condenser are integral with the column. The reflux from the condenser falls directly back into the column, and the overhead product is withdrawn as a vapour from the dome of the condenser. There is thus no reflux drum and no reflux pump.

Four External Streams

Apart from the feed, which may be constant or variable, there are four external streams: the overhead and bottoms products and the streams carrying heating medium to the re-boiler and cooling medium to the condenser. In addition there are two important internal streams which may play a part in the control system. Whereas in a column without reflux condenser the vapour flow up the column is substantially the same as the flow of overhead product, and the flow of liquid down the column substantially the same as the flow of feed, this is no longer the case in the complete fractionating column. The two internal streams are virtually independent of the flow of feed and products, and are governed by the reflux ratio, which now becomes an important 'design condition'. With a high reflux ratio the internal streams may be very much greater than the flow of bottoms and overhead.

The internal and external streams are clearly not independent of one another. The amount of cooling medium passed through the condenser determines the liquid flow down the column, and the amount of heating medium traversing the re-boiler determines the vapour flow up the column. Assuming for the moment that the feed is constant, what are the design conditions of a complete fractionating column?

Essential Conditions

Two conditions have to be maintained to ensure the balance of heat and matter essential for the stationary state:

(1) The pressure must be kept constant.

(2) The liquid level in the re-boiler must be maintained.

Clearly these conditions are necessary but not adequate to make the column deliver a pure overhead and a pure bottoms product. Two further design conditions have to be imposed and these are generally expressed as follows:

(3) The reflux ratio has to be kept constant or above a minimum value.

(4) The boil-up has to be so regulated in conjunction with the reflux that the relative amounts of overhead and bottoms product are the same as the relative proportion of the two components in the feed.

Neither of these two conditions can be expressed immediately as control variables to be held constant by the regulation of streams, but it is not difficult to find a number of controllable variables, two of which can serve to maintain these conditions constant.

Reducing the Possibilities

The number of possibilities may be reduced by providing, as before, a pressure controller regulating the overhead gas stream and a level controller regulating the flow of liquid bottoms product, but the two product streams cannot then be flow-controlled. Of the remaining streams, either the internal or the external may be regulated.

This can be done for the external streams by keeping constant two variables measuring reflux ratio and boil-up. Thus, a flow meter can be placed in the reflux stream and a differential pressure controller used to measure the vapour stream up the column. Logically the former will actuate the valve admitting cooling medium to the condenser, and the latter will regulate the flow of heating medium to the re-boiler.

Alternatively, one of the streams can be controlled by temperature at a point in the column, or by temperature difference between two points in the column. It would not be so easy to set the external streams and regulate the liquid and vapour flows in the column, for this would necessitate the introduction of internal valves which would be difficult to install and would materially interfere with the design of the unit.

If the feed is variable in quantity only, the flow controllers would need re-setting by feed, the temperature controller would be practically independent of feed quantity. If the feed is variable in composition also, a simple re-set would be inadequate and the complete automatic control of the column would be complicated.

Apart from composition changes which may have to be dealt with separately, four controllers, with or without re-sets, are adequate for the control of a column of this type having four streams that can be independently controlled.

Plastics & Building

Growing Demand for Floor Coverings

THE growing importance and application of plastics in the building industry was reviewed by Mr. L. H. Griffiths, M.Sc., F.R.I.C., A.I.R.I., technical manager of Semtex, Ltd., in a paper read to the southern section of the Plastics Institute and the Institution of the Rubber Industry in Southampton on 12 March.

In the flooring field in particular, said Mr. Griffiths, a great contribution was being made by plastics both to domestic and to commercial building. In housing, synthetics, in the form of thermo-plastic tiles, were now being used on a great scale as a most suitable surfacing for concrete floors.

Synthetics in emulsion form which could be mixed with cement to provide self-coloured, hygienic and easily cleaned floors to blocks of flats, light industrial buildings and similar concrete structures, filled a need which could not possibly be met in any other way than by the use of plastics.

Looking to the future, the speaker maintained that the demand for plastics in floor coverings was not likely to disappear with a return to something more like normality in the building industry. The reverse, indeed, might well be the case.

PVC Developments

Developments in the polyvinyl chloride range of resins promised newer and more flexible—and therefore more durable—coverings which would find a ready market in Great Britain. Already the way was being pointed to in the United States of America. It was certain that synthetics would make a similar appeal all over the world and it might well be that the greatest volume usage of the raw materials of plastics would eventually lie in the manufacture of floor coverings.

A corollary of this was that resin producers might reasonably consider the building industry as capable of absorbing a largely expanded production of certain synthetic resins. Besides contributing towards an even flow of supplies of these resins to other industries, this stabilising of the market would enable the chemical industry to maintain research and development at the high level of efficiency necessary.

'Internal' Electrolytic Titration

Dispensing with an External Current Source

ONE of the most important necessities for accurate electrolytic titration is good current stability. Many devices have been developed, in the U.S.A. and elsewhere, but these are rendered unnecessary if the current is developed in the analytical apparatus itself, with zinc and platinum electrodes, diaphragm and ammeter; current intensity being easily controlled by varying the depth of immersion of the zinc electrode. One form of this 'internal electrolysis' has been described by A. Schleicher (*Z. Analyt. Chem.*, **130** (1), 425, 1949; **131**, 325, 1950), but this involves much time, and is in any case not quantitative, though it may serve as a basis for further improvement (*Angew. Chem.*, **63**, 557, 1951; **64**, 24, 1952; *Stahl. u. Eisen*, **69**, 33, 1949).

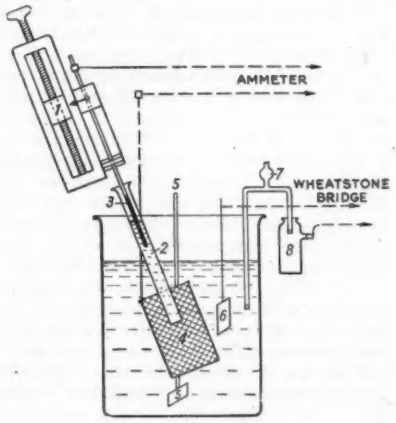
External Current Source Used

Professor W. Oelsen and co-workers, of the Mining Academy, Clausthal/Harz (Iron-working and Foundry Inst.), however, have recently reported the results of work on electrolytic titration without external current source, in the determination of acids and sulphur and in the electrolytic reduction of manganese, chromium, and vanadium (*Angew. Chem.*, **64** (3), 76-81, 1952).

A zinc electrode coated with a collodion film may be used in a solution containing both alkali sulphate and sulphuric acid together with a platinum gauze electrode, and an ammeter in circuit. Strength of current is controlled by varying the immersion depth of the zinc electrode. The gauze electrode acts as a platinum cathode to which the same current strength has been applied from the outside, and the sulphuric acid is neutralised in accordance with Faraday's law. Injected oxygen gas serves as stirrer. The solution, however, must be still at the point of immersion of the zinc electrode; and this is achieved by inserting this electrode inside the platinum gauze. (*see* figure opposite). The internal circuit is closed with a platinum plate below. Other accessories for maintaining constant current (resistances, etc.) are unnecessary, except that a galvanometer is needed. This simple device gives very accurate determinations as shown in the tabulated results (found and calculated) for sulphuric acid titration, and for determining the sulphur content of steel (0.028 to 0.195 per cent).

In reduction tests or titrations of oxidation agents, the zinc electrode may be placed in a glass tube with a collodion film-covered bottom to separate it from the solution. Alternatively, it may be coated as above with collodion, and inserted with the platinum gauze electrode in a solution containing, say, potassium permanganate. With the circuit closed through an ammeter, the permanganate is reduced at the platinum electrode instead of hydrogen being formed there. Reduction proceeds *pro rata* with current strength, and is unaffected by the hydrogen forming at the zinc electrode. In the absence of a reducing agent hydrogen formation at the platinum electrode is exactly proportional to current flowing. Manganese, chromium, and vanadium were found quantitatively in a similar manner.

But these reactions only quantitatively conform to Faraday's law under the following conditions: (1) The active surface of the cathode must be large—as can be assured by using gauze and vigorous stirring of the solution; (2) a substance more difficultly reducible than the test material must be present in excess; (3) there must be no side reactions. Using a zinc electrode of 5 mm. dia. and



55 mm. long, current strength may be varied from 0.001 to 0.5 amp. by change of temperature and acidity of solution and depth of immersion of the zinc, or solely through moving the zinc rod. The best current strength is usually below 0.2 amp.

The apparatus used is shown above. It consists of a glass beaker or like container, holding a solution in which a platinum gauze electrode is immersed (4), with stirrer (5), platinum indicator electrode (6), zinc electrode (3) in glass tube (2), closed at base with collodion film, and with a handscrew adjustment (1) for immersion depth. Also shown are circuit-closer (7) and reference electrode (8). Methods of use are described in connection with a potassium permanganate solution, and the results are graphed and tabulated, showing again very good agreement between found and calculated values. (Readings were made on a millivoltmeter with compensator; but for direct measurements a Hiltner twin voltmeter was found most suitable; the starting point is at the beginning of the current flow, and the end-point is at the potential rise.)

Similar tests were made for chromium in iron or steel—with and without tungsten—vanadium, and for chromium and vanadium together. The steel for the first of these tests was dissolved in sulphuric and phosphoric acids, and to the diluted solution (200 ml.) were added silver sulphate and ammonium persulphate solutions. The mixture was then boiled for 10 minutes to drive off oxygen. The chromium together with the manganese is oxidised, and may be again reduced without affecting the chromate by addition of some common salt to precipitate silver. The solution is kept boiling until the red colour disappears, and after rapid cooling is electrolytically titrated at 25°C.

The Lord President of the Council, with the approval of the Prime Minister, has appointed DR. B. K. BLOUNT, Ph.D., F.R.I.C., to be a Deputy Secretary in the Department of Scientific and Industrial Research. Dr. Blount, who at present holds office as Director of Scientific Intelligence in the Ministry of Defence, is expected to take up his new duties in April next. Dr. Blount's post is a scientific one. The burden on the Secretary Sir Ben Lockspeiser, is heavy, and Dr. Blount's appointment is intended to relieve him.

Volumetric Glassware

New Tables for Use in Calibration

IN response to requests from the National Physical Laboratory and from industry for the publication of tables, in compact and readily accessible form, for use in the calibration of volumetric glassware a new British Standard has now been prepared. Tables used hitherto are no longer easily obtainable and do not relate to present-day apparatus, which is standard at 20°C., and not 15°C. as formerly.

Two sets of tables are contained in the new standard (B.S. 1797: 1952). One relates to vessels made of soda glass and the other to those made of borosilicate glass.

Each set of tables is appropriate to the conversion of the observed weight, in grammes, in air of average density, of the distilled water contained or delivered by a glass vessel at a known temperature, into the volume of the vessel at 20°C.

Conversion Table Provided

Tables are also provided for the correction for the departure of the effective air density from the average air density assumed in the tables mentioned above; conversion of the weight in air of the mercury contained or delivered by a glass vessel at a known temperature to the volume of the vessel at 20°C.; and conversion of the nominal volume of a glass vessel at 20°C. to the weight in air of the mercury contained or delivered by it at various temperatures.

The tables allow for the current density of the liquid, the change of volume of the vessel with temperature, and the buoyancy of the air during the weighing.

Basic figures from which the working tables have been calculated were prepared by the National Physical Laboratory.

Values used for the coefficient of cubical expansion of glass in the tables for soda glass and borosilicate glass are good average values for the two types of glass used for volumetric glassware manufactured in the United Kingdom. When the expansion of the glass is known to differ from that used in the tables and the temperature of water is far removed from 20°C., it may be necessary, when working to a high degree of accuracy, to make adjustment.

Copies may be obtained from the British Standards Institution Sales Branch, 24 Victoria Street, London, S.W.1 (10s. 6d.).

Proton-Free Inorganic Solvo-Systems

Recent German Work on their Characteristics

A FAIRLY comprehensive review of recent work on ionising solvents and solvo-systems has been given by Drs. H. Spaundau (Braunschweig) and V. Gutman (Viena) in *Angew. Chem.* (1952, **64** (4), 93-103, 21 February) with extensive bibliography for the various solvents. (For the most part they use the Latin forms: solvens and solventien—Sing. and Plur. respectively—to indicate ionising solvents in accordance with the now accepted convention).

Use of Ionising Solvents

It is now well realised that a large number of inorganic compounds can be used as ionising solvents. The electrolytes dissolved therein are classed, according to their behaviour, as solvo-acids, solvo-bases and solvo-salts, and their interactions represent solvo-neutralisations or solvolytic reactions. In this way the solvo-systems yield new information on the reciprocal action between solvents and solutes, and help to clarify the acid-base problem. Their specific properties, as contrasted with water, permit new developments and fundamental advantages in synthetic organic chemistry.

These solvents may be divided into proton-containing (water, anhydrous ammonia, hydrogen sulphide etc.) and proton-free (sulphur dioxide and many others referred to below). The chief physical constants and chemical or physico-chemical properties of the first class are listed in the above paper and briefly discussed. The most important factor is no doubt dissociation of the solvent molecule determining the nature of the dissolved electrolyte as solvo-acids, -bases, -salts, or amphoteric compounds; also what reactions are to be regarded as solvo-neutralisations or solvolytic conversions. Some dissociation data for the proton-containing solvents are tabulated giving solvo-acid cations and solvo-base anions. Besides their common properties this group also exhibits various differences, e.g., in dissolving powers and ionising effects; also in degree of activity—mild, medium, and intensive, ranging from H_2S for the first to HF for the last.

The main part of the review is devoted to the proton-free class, of which the chief physical constants are tabulated. They are again subdivided into groups beginning with the non-metallic oxides comprising SO_2 and N_2O_4. The former of these is considered in detail. Like the proton-containing solvents, SO_2 can form solvates, and its properties both in the inorganic and organic fields are described. Its low di-electric constants and relatively large molecular volume are limiting factors. Among organic compounds whole groups are readily soluble in SO_2, such as alcohols, phenols, acids, esters, nitro-compounds, etc. But the amines alone appear to form potential electrolytes of a basic nature, while all other organic substances show practically no conductivity. The solubility of inorganic salts is generally in direct relation to the volume of the constituent ions, instances given being alkyl-substituted ammonium salts, iodides, etc. Other examples of the action of SO_2 as ionising solvent include sulphite-acids, -bases, and -salts, amphoteric compounds, oxidation-reduction reactions, and the formation of chloro complexes. All these latter, including, especially, chloro-antimonates are strong electrolytes and solvo-salts.

Solvent Behaviour of N_2O_4

Besides its thermal dissociation into two NO_2 molecules, N_2O_4 is also electrolytically dissociated into the nitrosyl cation and nitrate anion. In its solvent behaviour it has a closer similarity to SO_2 than to water or ammonia; for example, the solvates have low stability and its addition compounds with inorganic salts are relatively few. Although it is a good solvent for certain non-metallic elements and for certain classes of organic compounds it cannot be said to be a strong ionising solvent. So far there has been insufficient research in this particular field to enable one to evaluate it very definitely. Its solvo-system is of course easily distinguished according to the ions split off into acids, bases and salts.

Of the nitrosyl compounds NOCl is briefly described; among the bases, ammonium nitrate; and among others the ansolvo-base, diethyl-nitrosamine. As to the question in which direction the reversible solvo-acid/solvo-base reaction takes place in a given

case, this apparently depends to some extent at least on solubility conditions, that is, whether the solvo-salts, for example, are soluble or not in N_2O_4; as shown in the case of diethyl-ammonium chloride, from which, after driving off the NOCl, the solvo-base or nitrate is quantitatively obtained. The behaviour of metals in the tetroxide has been more thoroughly studied. Many of them form difficultly soluble nitrates as with proton- (or hydrogen)-containing solvents By addition of NOCl to the solvent the metals are much more vigorously attacked. The weak solvo-base zinc nitrate exhibits amphoteric behaviour in N_2O_4.

Anhydrous Acid Chlorides

The next group considered comprises the anhydrous acid chlorides, such as the nitrosyl, carbonyl, selenoxy, and thionyl chlorides. The first forms fairly stable solvates and has a relatively high dissociation constant (α) compared with that of ammonia. As before, the formation of solvo-salts, -bases, etc., is briefly discussed, and it is pointed out that some of the ionising NOCl reactions are of interest in preparative or synthetic chemistry, as in the reactions between the strong solvo-acid $NO(SbCl_6)$ and the tetramethyl ammonium salts of weak solvo-acids. These precipitations, especially the perchlorate reaction, may be used for detecting nitrosyl ions, though only for relatively high NO^+ ion concentrations. Much the same ground is covered in respect of the other chlorides in this group (phosgene, etc.).

Passing now to the iodine and interhalogen compounds, the properties of melted iodine have been extensively studied. Its electrolytic dissociation is clearly very small. In this solvo-system the metal iodides or polyiodides act as solvo-bases while the iodohalogenides and -pseudohalogenides (halides) are solvo-acids. Basicity of the solvobases declines in order from the very strong KI, RbI, LiI, through moderate NaI, to the weak AlI_3, FeI_3, etc. The acids are mostly very weak electrolytes, with declining acidity from ICl, IBr and ICN. There are numerous solvo-neutralisation reactions—between solutions or suspensions of the metal iodides and solutions of the iodine halides. Some very weak solvo-bases are amphoteric in liquid iodine (HgI_2, PbI_2 and BiI_3). Bromotrifluoride is an exceptionally strong solvens (ionising solvent) and its solvent power for fluorides equals that of water; but its active fluoridising and oxidation properties are a limiting factor in the study of fluorine. Yet its ionising properties combined with this fluoridising character are of great value in the production of fluoro-complexes. Other solvents described include iodo-pentafluoride, melted iodo-monochloride, and iodo-bromide.

The next two sections deal respectively with arseno-halogenides and melted mercuric bromide. The authors conclude generally that, although the number of proton-containing and proton-free ionising solvents (solventia or, in Germany, *Solventien*) has become very large and research in various directions has been pursued extensively and persistently, a comprehensive and well coordinated system is yet far from realisation. It is known that certain factors such as autoconductivity, molecular volume, dissociation constant and other physical data must play an important part in the ionising properties of a compound. But a knowledge of these data alone is insufficient for deducing definite conclusions on ionising (solvent) powers. Further study with all the powerful modern resources of physical chemistry is therefore essential.

A *Canadian Ruhr*

FIVE new chemical plants being built in Quebec province at an expenditure of millions of dollars will turn the St. Lawrence Valley into a Canadian version of the Ruhr, Dr. Leon Lortie told a meeting of the Textile Society of Canada. Speaking on the chemical geography of Canada, he said Canada's chemical industry is one of the biggest of the nation, with an output last year of $750,000,000.

'If we total all the industries based on chemistry—metallurgy, pulp and paper, petroleum refining, food industries and a great deal of new textiles—it would exceed total farm production of $2,000,000,000,' he said.

The products of the new plants will be polythene and acetic acid used in the manufacture of cellulose and cellulose acetate; benzene and butadiene intermediates in nylon production; and pentaerythritol for making plastics and explosives. Other products named were acetone, phenol, acetylene, calcium carbide, formaldehyde, phosphate, phosphorous and phosphoric acids.

Improved Ethylene Production

Different Processes Available for Important Product

IN the booming petrochemical industries, ethylene is to-day a keystone. Consumption in the United States alone has risen from 74,000 tons in 1943 to 667,000 tons in 1950. Beyond this, a 1962 consumption of nearly 1,780,000 tons has been predicted by a recent careful market study.

The principal present-day outlet for this basic olefine is ethylene glycol, manufactured chiefly for the automotive antifreeze market. This chemical accounted for fully one-third of the total ethylene produced in the U.S.A. in 1950. An almost equal amount went into the production of synthetic ethanol, which constituted in 1950, 56 per cent of the total ethanol output (up from 17 per cent in 1945). Other important consumers of ethylene include ethyl benzene (intermediate in the production of styrene) and various halogenated derivatives. Important in the latter class is ethylene dichloride, an intermediate in the production of vinyl chloride monomer.

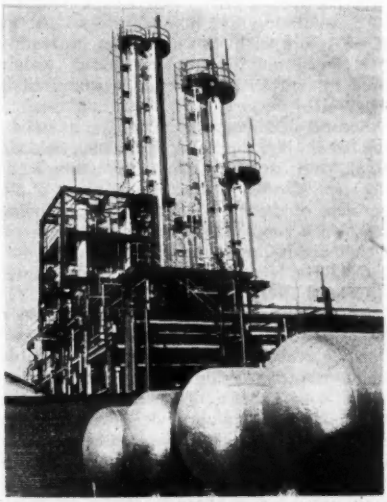
Polyethylene Plastic Growth

Perhaps the most significant development of recent years in the field of ethylene chemistry has been the striking growth of polyethylene plastic, produced by the high-pressure catalytic condensation of ethylene. This plastic, which was first introduced commercially in 1944, is to-day already being produced at the rate of 44,500 tons annually. Demand for it seems insatiable, and it is, indeed, the only plastic which is still in critically short supply in America.

The impact of these market developments on ethylene production has been tremendous. The material is almost wholly derived from petroleum sources, and an increasing number of refiners have turned to producing this olefine either for their own petrochemical purposes or for sale to users more immediately interested in the chemical markets. Typical is the 53,300 tons/year ethylene plant (the world's largest) which is now under construction at Gulf Oil Corporation's Port Arthur, Texas plant. According to present plans, none of this output will be used by the manufacturer. Instead, the ethylene gas will be sold and piped to various chemical producers who are now in the process of erecting ethylene consumer plants within a 50-mile radius of Port Arthur. In addition, plans are afoot for the pooling of ethylene to be recovered from refinery gases in various plants in the Texas oil fields and piping the gas to interested users throughout the area.

Projects of this kind are, of course, of equal interest to Canadian refiners, and indeed to any area where a concentration of refineries sets the scene for a chemical industry based on ethylene. Research in the field of ethylene production has kept up with market development and a growing array of suitable processes is now at hand.

For relatively small operations, the use of by-product ethylene may be quite adequate. This olefine abounds in refinery gases derived from various thermal processes. Typical concentration of the gaseous product of vapour-phase cracking is 20-25 per cent, while polyformer gases may run as high as 10 per cent ethylene. Gases from catalytic cracking run a poor third with only 5 per cent ethylene. Of course, it is possible to boost the ethylene concentration in



[*Courtesy, Dow Chemical Co.*

Ethylene fractionating towers and storage tanks

any of these gas streams by operating at more drastic conditions. However, to the refiner, ethylene is usually only a by-product, and the cracker operation will be directed above all to the production of petrol. This is as it should be, because normal cracking processes are not designed to yield ethylene preferentially. Attempts to raise output of this olefine would result in the simultaneous formation of excessive amounts of methane along with large amounts of heavy ends.

Hydrocarbon Stocks Range

A wide range of hydrocarbon stocks is suitable for the preferential production of ethylene, all the way from ethane to topped crudes. The actual choice of raw material depends on a large number of economic factors. From a yield point of view, the ideal charging stock is, of course, ethane, which need merely be dehydrogenated according to the reaction:

$$C_2H_6 \rightarrow C_2H_4 + H_2 \text{ ..... (1)}$$

The reaction is accompanied by a minimum of side reactions and laboratory yields in excess of 88 per cent have been reported. In practice, certain difficulties are encountered with ethane as raw material, since it is a particularly refractory material which calls for very high temperatures. Nevertheless, engineering experience in high-temperature processing has now developed to the point where such difficulties can be readily overcome, and ethane is, indeed, widely used for ethylene production whenever it is available.

Second in importance to ethane as cracking stock is propane. Ethylene yield in single-pass cracking from this source is, however, limited to something short of 50 per cent of theory. The ethylene-producing reaction (2) must compete with reaction (3) which yields propylene and hydrogen:

$$CH_3CH_2CH_3 \rightarrow CH_2{=}CH_2{+}CH_4 \text{ ... (2)}$$
$$CH_3CH_2CH_3 \rightarrow CH_3CH{=}CH_2{+}H_2 \text{ ... (3)}$$

As the molecular weight of the feedstock increases, the number of possible side reactions increases, thus limiting the possible single-pass conversion to ethylene progressively. As a matter of fact, some of the by-products (e.g., propylene formed in equation [3]) are suitable for recycle for increasing ethylene yields. However, as is the case in all cracking operations, these hydrogen-deficient charging stocks are more refractory feedstocks, which call not only for a higher operating temperature, but which also exhibit a strong tendency towards polymerisation and eventual coke formation. In the case of liquid hydrocarbon feedstocks, such as a straight-run paraffinic gas oil, the ethylene yield is thus limited in practice to about 30 weight per cent.

Two fundamentally different processes are available for the production of ethylene from hydrocarbon feedstocks: thermal cracking and partial oxidation. With one exception, all ethylene plants on stream to-day are operated by some thermal cracking scheme.

The most common process of this type involves cracking in a pipe-still at temperatures between 1,400° and 1,500°F. Outlet pressure varies between 10 and 30 p.s.i., with the lower pressure favoured for a relatively high-molecular-weight feedstock, with its greater tendency towards side reactions. Normal residence time varies between 0.7 and 1.6 seconds, and flexibility is given to furnace operation by varying the outlet temperature. Raising the mean reaction temperature will decrease the overall yield of ethylene but it will boost the per-pass conversion, and with it the cracker capacity. An economic balance must therefore be struck between ethylene output of the furnace and raw materials utilisation, based on locally prevailing conditions.

Steel Selection Problem

One of the principal problems in the design of pipe-stills for operation at the high temperatures required for ethylene production, is the selection of steels for the cracking coils. Most satisfactory from the point of view of high-temperature strength alone are high-chromium alloy steels, notably 25/20 chrome-nickel steel. Recent works by the Phillips Petroleum Company has, however, shown that this steel is inferior to 18/8 chrome-nickel steel from the point of view of high-temperature resistance to erosion by carbon particles formed in the process. The conclusions drawn from this finding favour the use of 18/8 stainless steel in parts of the furnace where cracking conditions are less drastic.

Because of the severe materials difficulties and high construction costs of coil-type furnaces for ethylene production, alternate processes for the high-temperature thermal cracking of hydrocarbons have been

developed. Most important is the thermofor pyrolysis of Socony-Vacuum Oil Company which is an outgrowth of thermofor catalytic cracking (T.C.C.).

Two primary elements compose the thermofor pyrolytic system: a reaction chamber and a primary heater. The hydrocarbon is introduced into the lower (reactor) chamber where it is contacted countercurrently by highly preheated pebbles. The cracked gases leaving the reactor are immediately quenched in order to minimise subsequent yield losses due to polymerisation and condensation reactions. The pebbles leaving the bottom of the reactor are lifted to the upper (heater) chamber where they are heated in direct contact with burning fuel gas. Coke formed in the course of the reaction step is removed from the pebbles in the heating chamber where it serves as supplementary fuel.

The process is thus characterised by high thermal efficiency, operation with a large range of feedstocks and suitability for high operating temperatures and consequent high throughputs (absence of metal failure problems permits operation as high as 1,700°F.). At the same time, the problem of coke formation is neatly solved. Disadvantages rest principally in the need for a mechanical conveying system for the pebbles and in the loss of the high-temperature pebbles by spalding and abrasion.

Partial Combustion

Only one installation is known to the author where partial combustion has served for the commercial production of ethylene. Operation here is on a once-through basis. The reactants are ethane and oxygen (of approximately 95 per cent purity) which are mixed in the ratio of 3 to 1 after having been preheated as high as is feasible (1,100° and 750°F., respectively). The reaction is carried out in a refractory chamber filled with ceramic spheres. Operating conditions are 3-400 mm. Hg absolute and 1,620°F. maximum temperature. Overall ethylene yield is 60-65 per cent.

Four different processes are available to the ethylene producer for final concentration and purification. In most common use is low-temperature fractionation, which is most suitable if the cracker product is relatively rich in ethylene. Ethylene may be concentrated from more dilute streams by oil absorption and the concentrate can then be finally worked up by low-temperature distillation. Highly suitable for very dilute streams of ethylene (e.g., some refinery gases) is the use of continuous countercurrent adsorption on activated charcoal in the 'hypersorption' process.

The fourth possibility, suitable only for stocks which are substantially free of emulsion-forming higher hydrocarbons, is absorption in solutions of cuprous salts, followed by thermal stripping. This latter method requires complete removal of acetylene contained in the feedstock because of the possible formation of hazardous copper acetylides. Suitable hydrogenation processes for this are available.

Painting—Codes of Practice

THE Council for Codes of Practice for Buildings has now issued in final form Code 231, 'Painting'. It was drawn up by a Committee convened on behalf of the Council by the Royal Institute of British Architects, and the present code is a devision of drafts previously issued for comment. The Code relates to the painting of buildings for the purposes of decoration, protection or hygiene, and includes a head code dealing with general considerations, and subcodes on particular aspects of painting wood; building boards, sheets and slabs; iron and steel; non-ferrous metals; plaster, concrete, brick and stone; lime plaster; calcium sulphate plasters; Portland cement concrete, plastering and rendering; brickwork; and stone masonry. A comprehensive list of definitions of terms relating to materials and a fully descriptive schedule of paint types is included.

The Code deals with all important points in the processes involved and gives recommendations on the selection of paints for different situations and materials, on the preparation of surfaces, application of primers, undercoats and finishing coats. The causes of some common defects in finished work are set out and recommendations made for avoiding their occurrence. Various appendices to the Code complete a document which should prove of great value to the profession and trade.

Copies may be obtained from the British Standards Institution, 24/28 Victoria Street, London, S.W.1, price 10s. post free; reference CP 231 (1952).

Importance of the Plant Engineer

Forthcoming Conference at Harrogate

GROWING realisation of the vital part played by the plant engineer due to increasing mechanisation of modern projects, the difficulty of obtaining new equipment, and therefore the special need for maintenance and getting the best out of existing plant, were emphasised at a conference for members of the trade Press held in London by the Institution of Incorporated Plant Engineers on Friday, 14 March.

The object of the meeting was to give advance details of the Institution's fifth annual conference to be held at Harrogate from 21-23 May, and to introduce the president-elect, Mr. G. A. Rooley, A.M.I.Mech.E., M.Inst.F., M.I.H.V.E.

Definition in Bye-laws

Plant engineers, according to the formal bye-laws of the institution, are those engaged in a supervisory manner on the maintenance or control of fixed or mobile plant.

The institution accepts as corporate members such 'fixed' plant engineers as the chief engineers in charge of engineering plant in industry, in municipal and service establishments, together with their assistants or maintenance engineers or sectional engineers; also such 'mobile' plant engineers as the chief engineers and maintenance engineers in charge of contractors' plant.

In addition, those responsible for the design and erection of such engineering plant are eligible, and executives who are in technical charge of the purchase, erection and maintenance of such plant, irrespective of their particular title.

But the fundamental rule is that all such men should be technicians holding executive positions of responsibility and not manual employment.

Membership is at present by scrutiny of practical qualifications or by thesis, but a formal education scheme is in preparation in collaboration with technical college authorities and full details will be available in about a month.

Theme of the Harrogate conference will be 'The Scope of the Works Engineer.' It was felt that such a subject should appeal to all members, for the works engineer is often expected to have knowledge of mechanical, civil and electrical engineering, heating, refrigeration, water, gas, steam and also to be something of a chemist, metallurgist, draughtsman and economist.

Production Costs

In his presidential address, Mr. Rooley will speak on 'The Plant Engineer and Production Costs,' when he will stress the rôle of the plant engineer in the production of goods and machines to meet the requirements of increasingly competitive trade.

Every item in the provision and maintenance of plant and services is a factor within the structure of price fixing. Thus, efforts to purchase raw materials in a good market become almost pointless if money is going to be thrown away during the passage of those raw materials through the various production stages, each one of which is directly related to the plant engineer and his responsibilities.

'Functions and Responsibilities of the Works Engineer,' will be discussed by Mr. D. Holland (chief works engineer, Serck Radiators, Ltd.). Emphasis will be laid on the maintenance of plant, buildings and services and attention drawn to the necessity of having a well staffed and equipped department, an adequate record system and good storekeeping. Other points to be discussed will include safety requirements, modern factory layout and adaptation of buildings, also use of colour technique and improved lighting.

Membership Figures

The institute now has 2,300 members of whom some 270 are overseas in many parts of the Commonwealth, Europe and the U.S.A. There are 16 branches in the United Kingdom with headquarters in Birmingham, and two overseas, one at Bombay, India, and the other at Colombo, Ceylon.

A national conference is held once a year and the first Scottish regional conference was held at Dunblane, last October. Reports of meetings and special news are available through the medium of the institution's *Journal* published bi-monthly.

The Analytical Chemistry of Potassium

Part I : The Use of Inorganic Reagents

AN examination of previous work concerning the determination of potassium shows that it has been a major problem since the early days of analytical chemistry.

The atomic structure of potassium is such that it has one *s* electron outside a completed electron shell and, as would be expected therefore, ionises very easily. Complex ion formation, or co-ordinate bonds must be attributed to this completed shell and in this respect potassium is similar to sodium and the other alkali metals. The only difference is the ease of deformation of the outer completed electron shell, due to the potassium atom having two complete electron shells of eight instead of sodium's one. This leads to a surprising number of methods available for the estimation of potassium in the presence of sodium.

This difference, however, does not hold with caesium and rubidium, and it must be remembered that almost all classical methods which separate potassium from sodium also separate rubidium and caesium with the potassium. Fortunately, however, contamination of a potassium precipitate on this account is usually very small.

The methods of estimating potassium fall into three main groups, inorganic, organic and physical, which will be considered in turn.

(1) THE USE OF INORGANIC REAGENTS

In this group are some of the oldest and most reliable methods which have been developed.

The Chlorplatinic Acid Method

This method depends on the fact that the potassium salt of this acid is insoluble in alcohol whereas the sodium salt is soluble. The alkali metals are separated as mixed chlorides from the other metals. They are then converted into the chlorplatinate, and the potassium salt, which precipitates out, is filtered, washed and dried.

The separation as mixed chlorides, however, makes the method rather time-consuming. Another difficulty presented by the earlier methods, as foreseen by Fresnius[1] and Precht[2] is that the sodium must be converted to the chlorplatinate before filtration, since sodium chloride is insoluble in alcohol and would therefore contaminate the potassium precipitate. As an alternative to absolute alcohol, Mellor[3] suggests mixtures of alcohol and water varying from 70-100 per cent alcohol. He also suggests methyl alcohol, mixtures of ethyl alcohol and ether, or of amyl alcohol and ether. Treadwell[4] recommends 96 per cent alcohol/water.

Ammonia interferes but Lejeurne[5] claims that the addition of formaldehyde to the solvent overcomes this difficulty.

An empirical factor is generally used to convert the weight of precipitate to the weight of potassium. It has been suggested that the possible reasons for this empirical factor include retention of water, replacement of chlorine by the hydroxyl or nitroso group, or the reduction of the platinum to the divalent state. Smith and Shead[6], however, claim that if lithium chlorplatinate is used as the precipitating agent, the precipitate has the theoretical composition, and an empirical conversion factor is unnecessary.

Alternatives to Weighing

As an alternative to weighing the precipitate, other procedures have been devised, such as reduction in hydrogen. This gives hydrochloric acid, potassium chloride and platinum, any of which can be estimated. Reduction may also be carried out using magnesium, zinc, formic or oxalic acid[7]. Fabre[8] recommends using magnesium in a warm solution, and then titrating the chloride formed. Diamant[9] recommends using zinc in the cold, thus avoiding any complications through the formation of magnesium oxychloride. Hicks[10], uses magnesium, but weighs the metallic platinum which is formed. This procedure eliminates interference from phosphates, borates, sulphates and other ions which generally cause trouble.

Bullock and Kirk[11] carry out the estimation on the micro scale by reduction with magnesium in neutral solution. The chloride is then titrated with silver nitrate using dichlorofluorescein as indicator.

Shohl and Bennett[12] titrate the precipitate using potassium iodide and thiosulphate:

$$K_2PtCl_6 + 6KI \rightarrow K_2PtI_6 + 6KCl.$$

$$K_2PtI_6 + 2Na_2S_2O_3 \rightarrow K_2PtI_4 + 2NaI + Na_2S_4O_6$$

Snell and Snell[13] have devised a colorimetric method, using stannous chloride as a reducing agent, which gives a yellow colour proportional to the amount of platinum present. Hurwitz and Batchelor[17] have also produced a micro colorimetric method after converting to the iodo-platinate. Spencer and Sen[14] proposed precipitation as potassium bromoplatinate with the advantage that a better conversion factor is obtained.

The Perchlorate Method

This method is based on the insolubility of potassium perchlorate $KClO_4$ in alcohol. However, although this fact had been noted by Stadion in 1818 and a method actually proposed by Serullas[16] in 1831, it was not until Kreider[18] described a suitable process for preparing perchloric acid[19] and the method became universally adopted[15].

Various organic solvents have been suggested by Willard and Smith[20,21] in particular, who investigated the solubilities of alkali and alkaline earth perchlorates in different organic solvents. They finally proposed a mixture of ethyl acetate and *n*-butyl alcohol as the most suitable.

One disadvantage of the method is the co-precipitation of perchlorates and perchloric acid on to the precipitate. If, however, the precipitate is filtered, redissolved and reprecipitated, the difficulty is largely overcome and the method is perhaps the most accurate known. Nevertheless it is time-consuming, and determination usually takes a full day.

The Periodic Acid Method

This compound has been recommended fairly recently as a precipitating reagent for potassium through the work of Willard and Boyle[22].

Potassium is precipitated in a solution of small volume by the addition of periodic acid. Precipitation is completed by adding a 50 : 50 mixture of ethyl alcohol and ethyl acetate.

The precipitate may be filtered, washed, dried and weighed, or reduced with potassium iodide to iodate, liberating iodine which may then be titrated.

The periodate method, however, has several disadvantages. For example, chloride ion interferes, sulphate ion interferes with the gravimetric procedure but not with the titrimetric method, and there are numerous common interfering metals such as iron, manganese and chromium which must be removed before the final precipitation.

Souchay[23] has modified the Willard and Boyle procedure by using a polarographic finish and he claims that the method is rapid and sensitive and can be used in the micro-determination of potassium.

Precipitation as Potassium-Sodium Cobaltinitrite

Potassium, under certain conditions, forms a compound $K_2NaCo(NO_2)_6$ which is insoluble in water and many methods have been advanced which involve the precipitation of this complex.

The compound is precipitated by cobalt nitrate and sodium nitrite and it was originally believed that sodium did not interfere.

De Koninck[24] introduced the use of the water soluble trisodium cobaltinitrite $Na_3Co(NO_2)_6$, as a precipitating reagent and later workers attempted to improve the method.

Adie and Wood[25] examined the reaction and developed a method using de Koninck's reagent in the presence of acetic acid. The precipitate was filtered and then decomposed by sodium hydroxide and the nitrite titrated with potassium permanganate. They claimed that the precipitate had a composition $K_2NaCo(NO_2)_6.H_2O$.

Drushel[26] modified the method by taking the precipitate to dryness on a steam bath. The dried mother liquor was then redissolved in dilute acetic acid, leaving the precipitate which he claimed now had a more constant composition.

Cunningham and Perkin[27] modified the procedure by using an excess of sodium ions in the reaction mixture and again claimed that the precipitate was constant in composition.

Misterlich, Celichowski and Fischer[28] modified the Drushel procedure by using sulphate as a wash solution instead of water. They found that the composition of the precipitate varied with the amount of precipitating reagent added.

Christensen and Fieldberg[29] precipitated in the presence of a saturated solution of sodium chloride. They found that the ratio potassium : nitrite decreased under these conditions and that a precipitate of constant composition could be obtained by precipitating with a fixed amount of reagent in the presence of a saturated solution of sodium chloride.

Milne[30], however, stated that the com-

position of the precipitate varied with the quantity of potassium present. To overcome this he altered the amount of reagent used according to the amount of potassium present. This, however, would seem to entail knowing fairly well the percentage of potassium present in the sample before the estimation begins.

Attention was turned to the ratio sodium: potassium in the precipitating solution. Bonneau[31] confirmed that the precipitate conformed to the Adie-Wood formula of $K_2NaCo(NO_2)_6.H_2O$ when the ratio sodium: potassium was greater than 25: 1. Below this ratio they claimed that the potassium content of the precipitate increased, tending towards a formula $K_3NaCo(NO_2)_6.nH_2O$.

Vurtheim[33] stated that the composition was $K_{1.5}Na_{1.5}Co(NO_2)_6$ but this was not confirmed by Bonneau.

Ryssselberge[32] examined the time taken for precipitation and stated that after 24 hours, the composition conformed to the Adie-Wood formula. He found that the weight of precipitate tended to a maximum on standing and that this time varied with the concentration volume of sample and method of stirring.

For this investigation he worked out a standard procedure using constant volumes and concentrations. Standing time was 24 hours.

Piper's Critical Examination

Piper[34] made a critical examination of some of the better methods. He found that the composition of the precipitate varied according to the amount of potassium present when Milnes' method was employed.

Lewis and Marmoy[35] recommended dropwise addition of the precipitating reagent and did not evaporate to dryness. On examining their method, Piper found that for a small range of potassium concentration, the precipitate formed was constant in composition, but did not conform to the Adie-Wood formula.

After thorough examination, Piper came to the following conclusions.

(1) The precipitate is of variable composition, the potassium always being less than demanded by the Adie-Wood formula.

(2) The ratio potassium: sodium in the precipitate increases with increasing potassium concentration in the solution.

(3) The composition of the precipitate varies according to the amount of reagent used. As the amount is increased, the ratio potassium: sodium decreases.

(4) Slow addition of reagent as recommended by Lewis and Marmoy causes variation in composition. The slower the addition, the higher the potassium: sodium ratio. The best results were obtained with rapid addition of the reagent.

(5) Temperature influences the results. The higher the temperature the greater the potassium: sodium ratio. This variation is considerably reduced when precipitation is effected by the successive additions of acetic acid, sodium nitrite and cobalt nitrate instead of the composite reagent.

He also stated that 35 per cent ethyl alcohol/water (v/v) was the best wash solution and that the precipitate is more soluble in sodium sulphate than in water.

Temperature Effect

Recent work by J. ten. Have[36] has confirmed the effect of temperature variation on the composition of the precipitate.

Piper, in his summing up, recommended a titrimetric finish with potassium permanganate. By analysing samples of known composition, he obtained an empirical factor which translated the potassium permanganate titre to the weight of the potassium present.

He obtained good results on the estimation of potassium present in amounts varying from 0.1 to 50.0 mg. by the method he proposed, and using the conversion factor which was

$$K_2O \text{ mg.} = \text{permanganate value} \times 0.354 + (\text{permanganate value})^2 \times 0.00034$$

where permanganate value = No. of mls. of 0.05N permanganate taken to oxidise the cobaltinitrite precipitate.

Wilcox[37] considered that the variation in composition was due to the instability of the nitrite which could form nitrate. Since it was known that nitric acid stabilises nitrites, he reverted to the use of trisodium cobaltinitrite with nitric acid as an acidifying agent. He claimed results indicating a precipitate of constant composition.

Although the cobaltinitrite method undoubtedly yields a precipitate of varying composition, under standardised conditions, this variation is not great and for many purposes, the use of an empirical conversion makes the method sufficiently accurate.

Refinements of the method have been continued up to the present day. The bulk

of this work has been on the final estimation of the precipitate itself.

Among the methods proposed is included the titration of the precipitate with potassium chromate suggested by Bourdon[38]. Cotte and Ducet[39] recommended reduction of the nitrite to ammonia using ferrous sulphate and silver sulphate. The ammonia is then titrated.

Physico-chemical finishes include the measurement of the quantity of the precipitate present by turbidimetry[40]. Kriventvoz[41] suggests measurement by nephelometry, but the paper indicates that the method is in fact turbidimetric. Tinsley and Pizer[42] have developed a rapid method using the Spekker absorptiometer.

Colorimetric Methods

Numerous colorimetric methods have been proposed. Sideris[43] used nitroso-R-salt which forms a red dye with the cobalt present. Jacobs and Hoffman[44] treated the cobalt with choline hydrochloride and sodium ferrocyanide, which forms a green solution. Wander[45] used a definite volume of standard potassium dichromate and measured the amount of reduction on a photoelectric colorimeter. Snell and Snell[46] described other methods. Fadl[47] used a folinciocalteuphenol reagent and added this with sodium carbonate to the precipitate. Again, a photoelectric colorimeter was used to measure the intensity of the colour formed. Jordan[48] decomposed the precipitate with sodium hydroxide and determined the NO_3 formed photometrically after calibration of the instrument against standards of known composition.

These physico-chemical finishes have made the method less time-consuming, but the uncertainty of the composition of the precipitate would seem to preclude an exact method being evolved.

(To be continued)

REFERENCES

[1] R. Fresenius, *Z. Anal. Chem.*, **16**, 63 (1877); **21**, 234 (1882).
[2] H. Precht, *ibid.*, **18**, 509 (1879); Ber., **18**, 2076 (1885); *Chem. Z.*, **20**, 209 (1896); *Lands. Ver. Stat.*, **47**, 97 (1896).
[3] Mellor, 'Treatise on Quantitative Analysis,' p.p 231-2 (Griffen & Co., Ltd., 1913).
[4] Treadwell and Hall, 'Analytical Chemistry' (1928).
[5] G. Lejeurne, *Compt. Rend.*, **227**, 434-5 (1948).
[6] G. F. Smith and A. C. Shead, *J.A.C.S.*, **53**, 947 (1931).
[7] Lunge and Keane, 'Technical Methods of Chemical Analysis' (1908).
[8] R. Fabre, *Chem. Z.*, **20**, 502 (1896).
[9] N. Diamant, *ibid.*, **22**, 99 (1898).
[10] W. B. Hicks, *Ind. Eng. Chem.*, **5**, 650 (1913).
[11] B. Bullock and P. L. Kirk, *Ind. Eng. Chem.* (*An. Ed.*), **7**, 178 (1935).
[12] A. T. Shohl and H. G. Bennett, *J. Biol. Chem.*, **78** 643 (1928).
[13] Snell and Snell, 'Colorimetric Methods of Analysi' (Chapman & Hall, London, 1936).
[14] E. Spencer and K. B. Sen, *Analyst*, **54**, 224 (1929).
[15] Mellor, 'Treatise on Analytical Chemistry,' p. 237 (1913).
[16] J. Serullas, *ibid.*, 1831, (2), **46**, 294.
[17] C. Hurwitz and H. W. Batchelor, *Soil Sci.*, **63**, 351-9 (1947).
[18] H. R. Kreider, *Am. J. Sci.* (3), **49**, 443.
[19] Mellor, 'Treatise on Analytical Chemistry.'
[20] H. H. Willard and G. F. Smith, *J.A.C.S.*, **44**, 2819 (1922); **45**, 286 (1923).
[21] H. H. Willard and G. F. Smith, *ibid.*, **47**, 762 (1925).
[22] H. H. Willard and A. J. Boyle, *Ind. Eng. Chem.* (*An. Ed.*), **18**, 187 (1941).
[23] P. Souchay, *A.C.A.*, **2**, 17-19 (1948).
[24] L. L. De Koninck, *Z. Anal. Chem.*, **20**, 396 (1881).
[25] R. H. Adie and T. B. Wood, *J.C.S.*, **77**, 1076 (1900).
[26] W. A. Drushel, *Am. J. Sci.*, **24**, 433 (1907); **26**, 555 (1908).
[27] E. H. Cunningham and F. M. Perkin, *J.C.S.*, **95**, 1562 (1910).
[28] Misterlisch, Celichowski and Fischer, *Landw. Versucho-Stat.*, **74**, 139 (1912).
[29] H. R. Christensen and N. Feildberg, *ibid*, **78**, 75.
[30] G. Milne, *J. Agric. Sci.*, **19**, 541 (1929).
[31] L. Bonneau, *Bull. Soc. Chim.*, **46**, 798 (1929).
[32] M. Rysselberge, *Ind. Eng. Chem.* (*An. Ed.*), **3**, 3 (1931)
[33] A. Vurtheim, *Rec. trav. Chim.*, **40**, 593 (1921).
[34] C. S. Piper, *J.S.C.I.*, **53**, 392 (1934).
[35] A. H. Lewis and F. B. Marmoy, *ibid.*, **52**, 177 (1933).
[36] J. ten. Have, *Chem. Weekblad*, **44**, 484-8 (1948).
[37] L. V. Wilcox, *Ind. Eng. Chem.* (*An. Ed.*), **9**, 136 (1937).
[38] D. Bourdon, *Chim. Anal.*, **31**, 154-8 (1949).
[39] J. Cotte and G. Ducet, *Ann. agron.*, **16**, 225-8 (1946).
[40] J. Tinsley, *Analyst*, **74**, 167-78 (1949).
[41] M. Kriventvoz, *Pedology, U.S.S.R.*, **1**, 52-4 (1947).
[42] J. Tinsley and N. H. Pizer, *J. Soc. Chem. Ind.*, **64**, 182-7 (1945).
[43] C. P. Sideris, *Ind. Eng. Chem.* (*An. Ed.*), **9**, 145 (1937); **14**, 821 (1942).
[44] H. R. B. Jacobs and W. S. Hoffman, *J. Biol. Chem.* (*An. Ed.*), **93**, 685 (1931).
[45] I. W. Wander, *Ind. Eng. Chem.* (*An. Ed.*), **14**, 471 (1942).
[46] Snell and Snell, 'Colorimetric Methods of Analysis' (Chapman & Hall, London, 1936).
[47] A. Fadl, *J. Biol. Chem.*, **44**, 282-5 (1949).
[48] P. Jordan, *Helv. Chim. Acta.*, **31**, 1483-7 (1948).

Sulphuric Acid Explosion

An explosion at the pickling tank end of a sulphuric acid pipeline was reported recently from Germany. The pickling tank was shut down for some weeks for repair and overhaul. On reopening the valve to the pickling tank, there was an explosion and a white slurry under considerable pressure was shot out of the tank, injuring a worker severely on the body and in the eyes. Subsequent investigation showed that the explosion was caused by hydrogen formed by the action of the acid on the iron, and that the slurry was iron sulphate. The slope of the pipe leading to the pickling tank was upward instead of downward, thus allowing the hydrogen to collect at the tank end of the line. Reversal of the slope allowed the hydrogen to be released harmlessly through the acid tank in future operations.

The Chemist's Bookshelf

PAINT AND VARNISH PRODUCTION MANUAL. By V. C. Bidlack and E. W. Fasig. New York, John Wiley & Sons; London, Chapman and Hall. 1951. Pp. ix + 288. 52s.

This may be called an unusual book, though this statement is in no sense intended to detract from its obvious merits. It has been prepared for the Federation of Paint and Varnish Clubs, to fulfil a need for the assembly in one volume of the basic principles of paint and varnish manufacture. It is intended for the education of production personnel and can be assumed to be representative of modern American practice. It is in this light that the book should be examined.

The first striking thing about the manual is the very large amount of practical 'know how' that the authors have managed to pack into this volume. This information is of the type which will help a junior executive through his early years, mainly in the question of organisation, and will point the way to his avoidance of hold-ups in production.

The book may be broadly divided into five divisions which deal respectively with plant, materials, processes, business and labour administration, research and process control. The first of these not only deals with individual items of plant, but covers factory layout as well: not forgetting such matters as fume exhaustion. The second is a résumé of the raw materials and finished products of the industry and obviously could not be very full. The third section deals with personnel and administration problems. This section, though it covers the ground, does not suggest the same useful guidance in avoiding pitfalls as the previous sections do. It is relatively too long. The section on research and control tells the production man all he needs to know, unless he is either at higher management level or is directly concerned with research. The section on safety and health is rather sketchy and in some parts misleading.

There is a lengthy bibliography at the end of each section, but this is almost entirely of American origin and so will not be of much value to a non-American reader. Despite these criticisms, the book will perform the function for which it is written adequately and well. It is quite worth the price asked for it and can usefully occupy a place on the desk of any executive.—A.W.

QUALITATIVE ANALYSIS. By R. F. Bromley. University of London Press. Pp. 125. 5s.

Careful training in simple qualitative analysis, with understanding of the reactions used and of the importance of clean and observant work, is essential as a basis for more advanced practical studies. This book, which was first published in 1950 and is intended to meet the needs of Intermediate B.Sc., 1st M.B., Conjoint Medical and G.C.E. (Advanced) students, should be of considerable help in such training.

Several features, not generally met with in books of this type, are to be welcomed. Part 1, about one third of the book, is devoted to explanatory notes and hints as a preliminary to the group tables. It includes a clear explanation of the plan of the group separations and quite full details of the use of H_2S, borax bead and flame coloration tests are given, among others. Emphasis is laid on cleanliness and order in working, and suggestions are made as to the method of recording results and for the arrangement of an orderly bench.

Following a specially designed set of exercises for the beginner, the actual tables are given in Part 2 in 'Flow Sheet' form, enabling the student to visualise the separations as a continuous process. A feature of the book is the pictorial representation of the group separations. This part of the book also includes a section on simple micro technique and spot tests, inclusions to be welcomed in view of the increasing use of these in analysis. Part 3 of the book includes a scheme for the identi-

fication of some simple organic compounds required in some medical practical examinations.

The book should be of great value in supplementing the work of the lecturer or demonstrator. The diagrams are clear and the book is well printed. Since it is likely to have considerable use by the student, stiff covers might be preferable to limp. The price is reasonable.—W.R.M.

MIT Summer Session

A SPECIAL programme on the colloid chemistry of elastic high polymers in science and industry will be held at the Massachusetts Institute of Technology from 16 June to 5 July, according to an announcement by Dr. Ernest H. Huntress, director of the MIT summer session.

The course is planned to present to those actively engaged in the production and industrial applications of natural and synthetic elastomers the latest information on the chemical composition, structure, and production of elastic high molecular colloids of organic and inorganic composition.

Explanation will be given of the elasticity of these compounds on the basis of most recent developments and the programme will include detailed discussion of their more important industrial applications and of their production on an industrial scale.

Dr. Ernst A. Hauser, Professor of Chemical Engineering at MIT will conduct the course. Special emphasis will be placed on concepts of new developments in the field and on possible ways by which present natural and synthetic elastomers could be improved.

New Group's Success

First Report of the Microbiology Group

INDEPENDENT status conferred by the council of the Society of Chemical Industry on the Microbiology Group last year, is shown to have been well justified in the annual report of its first session for 1951-52 now available.

Meetings had been well attended and followed by lively discussions. Membership had increased and was now 508.

The committee elected at the last annual general meeting had been further strengthened by the appointment of the following representatives of different sections:—Mr. L. M. Miall (London); Mr. C. L. Silverstone (South Western); Mr. G. Sykes (Nottingham); Dr. A. E. J. Vickers (Newcastle).

General policy of the committee had been to provide a judicious mixture of academic and applied subjects and to endeavour to appeal to the widespread interests of its members. Of the eight meetings comprising the programme for the session, three had been domestic in character, four arranged jointly with other groups or sections of the society, and one was a joint meeting with the Society for Applied Bacteriology.

Two symposia—one on 'The Use of Isotopes in Microbiology' and the other on 'Disinfectants'—each provided a galaxy of speakers and kept the audience interested throughout the afternoon and well into the evening.

The following were appointed to represent the Group on other committees:—

Mr. D. H. F. Clayson—BSI Committee on 'Universal Decimal Classification'.

Mr. C. E. Coulthard—(1) BSI Committee on 'Disinfectants'. (2) BSI Committee on 'Black and White Disinfectant Fluids'.

Mr. J. L. Yuill—BSI Committee on 'Fungal Restraint by Antiseptic Substances'.

Dr. L. A. Allen—Journals and Chemistry and Industry Sub-Committee of the Publications Committee.

Mr. H. J. Bunker was appointed chairman of the Journals and Chemistry and Industry Sub-Committee of the Publications Committee.

Sales & Service Transferred

THE Quasi-Arc Co., Ltd., Bilston, Staffordshire, announces that as from 1 April, 1952, sales and service of Unionmelt automatic welding plant, powder and wire, will be transferred to its associated company, Fusarc, Ltd., Team Valley, Gateshead-on-Tyne, 11.

Fusarc, Ltd., will continue to supply complete mechanised welding installations, including manipulators and other appropriate welding heads embodying either the Fusarc continuous covered electrode system, or the Unionmelt submerged arc system of automatic welding.

Skilled Unionmelt welding personnel are being transferred from The Quasi-Arc Co., Ltd., to Fusarc, Ltd., and full continuity in service and supplies can be assured.

OVERSEAS

Oil Drilling Project

Drilling operations for oil in the Exmouth Gulf area of the North-West of Australia will start in April. The cost of the first bore to be put down by Arnpol Petroleum Ltd., the prospecting company, is expected to be £A1,000,000. If necessary the company will drill to a depth of 13,500 feet. Its equipment includes two major drilling units, weighing 20 tons each and about 11,000 tons of plant will also be brought from California for the work. About 40 men will be employed on the project. They will be trained by American technicians.

Fluorides Not Endorsed

The Delaney Committee in Washington, investigating chemicals in foods, has declined to make any recommendations regarding the use of fluorides in drinking water. Most of the expert evidence, it reveals, was in support of the practice, but it has refused to endorse the idea one way or the other, in view of the fact that many aspects had been raised on which they had not sufficient evidence.

Production Commenced

Shell Oil Co. of Canada, Ltd., has started producing sulphur as a by-product of natural gas at its Jumping Pound plant in Alberta. This is the first time sulphur has been produced in this manner in Canada. The company uses a relatively new process of recovery from hydrogen sulphide and is expected to produce about 9,000 tons of elemental sulphur annually. Output will increase as the market for natural gas from the Jumping Pound gas field expands.

Selective Spot Test

Reported in *Chemical and Engineering News* is a highly selective spot test for iron reported to a regional meeting of the American Chemical Society. This consists of the use of β-resorcylic acid which gives a red complex with as little as 3 micrograms of ferric ion in a solution containing only 20 p.p.m. of iron. Most common metal ions give no interference, and those which do (mercury, antimony, calcium) give colours other than red. The test may even be worked in the presence of tungsten and molybdenum, although the colour fades almost immediately.

New Ammonia Factory

A new factory, capable of increasing South Africa's production of ammonia by 33,000 tons, and costing about £4,000,000, is being built at Modderfontein in the Transvaal. Hopes are that the factory, some of the equipment for which has been ordered from Britain, will be in production early in 1954. It will be able to supply enough ammonia for the manufacture of sufficient ammonium nitrate to meet the Union's full needs.

Davy Invention Used

Sir Humphry Davy, chemical pioneer, born in 1778, was the first man to show that cathodic protection could be applied to the copperclad bottoms of British vessels of the period to counter corrosion. His idea fell into disuse, however, because it was found that the clean copper surfaces exposed strongly attracted marine growths that slowed down the ships. Now, over a century later, an American ship—the *Marine Chemist*, a sea-going chemical transport leased by the Dow Chemical Company—has been installed with magnesium anodes for the protection of the ship's bottom.

To Process Fluorspar

Kaiser Aluminium and Chemical Corporation announced that it will build a mill in Nevada to process fluorspar for the production of aluminium metal. The new mill will receive fluorspar from the recently-acquired Baxter mine near Gabbs, Nev. The mill will include the necessary grinding and flotation equipment to process the ore into acid grade fluorspar concentrates.

Iron Ore Exploration

Iron ore is at present being prospected for in Mauretania, French West Africa by combined British, French and Canadian interests. If findings of initial surveys are confirmed, the potential output is estimated to be over 4,000,000 tons per year, it is reported. A 200-mile railway will have to be built across the Spanish territory of Rio de Oro, and the port of Villa Cisneros expanded, if the ore is to be exploited. Also a mining community would have to be started near the French Foreign Legion post of Fort Gouraud in the Sahara.

HOME

Commercial Production

Leda Chemicals, Ltd., of Wharf Road, Ponders End, London, announce that they are shortly commencing commercial scale production of *n*-butyl chloride, glycerine monochlorhydrin, glycerine dichlorhydrin, and epichlorhydrin. Interested consumers are asked to communicate with the firm in order that a market evaluation of the probable demand can be ascertained.

Fertiliser Bill

With only a few minor criticisms the Agricultural (Fertilisers) Bill was given its second reading in the House of Lords on 12 March. Lord Carrington, Parliamentary Secretary, Ministry of Agriculture, who said it was important to get the Bill on the Statute Book as soon as possible, also stated that the Government were interested in air spraying as a means of fertilising inaccessible land. He further indicated that the Bill was only a small part of a larger and grandiose scheme of which more would be heard in the not-too-distant future.

Record Attendance

A record number of members and guests attended the annual dinner and dance of the APV Athletic and Social Club held at Wandsworth Town Hall on 8 March. More than 300 people sat down to dine, a larger number than on any previous occasion, and in view of the impending transfer of many members of the company to the new factory at Crawley New Town, it is not expected that an APV social gathering on such a scale can be held for some years to come.

Iron and Steel Institute Awards

The Robert Hadfield Medal for 1951 has been awarded by the National Iron and Steel Institute to Dr. L. Reeve, of Scunthorpe, a member of the staff of the Appleby-Frodingham steel works, in recognition of his contribution to the science and practice of ferrous metallurgy and in particular for his researches on the welding of low-alloy steels. The Williams Prize was awarded jointly to Mr. J. A. Bond, blast-furnace manager of the Appleby-Frodingham works, and Mr. T. Sanderson, of the Workington Iron and Steel Company for their papers on blast-furnace practice.

Lead Price Reduced

The price of imported good soft pig lead was reduced on 18 March by £7 from £170 to £163 a ton delivered consumers' works. This reduction according to a Ministry of Materials announcement was made possible by lower prices negotiated with Commonwealth suppliers.

OCCA (Manchester) Annual Meeting

The 28th annual general meeting of the Oil and Colour Chemists' Association (Manchester Section) will be held at Sainsbury's Restaurant, Chapel Walks, off Cross Street, Manchester, on Friday, 4 April, at 6.30 p.m. After the business of the meeting a hot-pot dinner will be held, with entertainment by Mr. Bernard Carrington.

Group to Elect Officers

Recently announced is the 4th annual general meeting of the Fine Chemicals Group of the Society of Chemical Industry. This will be held at King's College (Chemistry Lecture Theatre), Strand, W.C.2, on Friday, 21 March, at 7 p.m. The election of committee members for 1952/3 will take place.

Ordinary Meeting

An ordinary meeting of the Society of Public Analysts and Other Analytical Chemists will be held at 7 p.m. on Wednesday, 2 April, in the Meeting Room of The Chemical Society, Burlington House, Piccadilly, London, W.1. The following papers will be presented:—'The Determination of Traces of Arsenic in Germanium Dioxide and Tetrachloride', by S. T. Payne; 'Inorganic Chromatography on Cellulose. Part IX. The Determination of Thorium by Chromatography on Alumina and Cellulose Adsorbents and the Simultaneous Determination of Thorium and Uranium in Minerals and Ores', by A. F. Williams, B.Sc., F.R.I.C.; and 'Inorganic Chromatography on Cellulose. Part X. The Spectrographic Determination of Micro Quantities of Thorium Separated by Chromatography from Minerals and Ores', by G. W. J. Kingsbury and R. B. F. Temple, D.Phil.

French Export Gains

Fertiliser Shipments Down in 1951

DESPITE a severe drop in exports of fertilisers and some basic chemicals last year, the overseas trade of the French chemical industry as a whole showed a further substantial improvement. Shipments to foreign destinations of potash salts fell from 1,029,778 metric tons in 1950 to 818,982 tons in 1951, phosphate fertilisers from 485,742 to 411,105 tons and nitrogen fertilisers from 72,369 to 46,753 tons.

Exports of caustic soda declined from 80,014 to 56,026 tons due to restrictions imposed by the Government, and those of sodium carbonate from 253,618 to 244,004 tons. The shipments of nitrogen fertilisers to French overseas possessions, were stepped up from 48,789 to 68,564 tons.

Total value of French chemical exports rose from 79,890,420,000 to 108,957,017,000 francs; shipments to foreign destinations alone advanced from 58,142,826,000 to 75,451,441,000 francs. The principal export groups last year were (in million francs): organic chemicals 10,156 (6,459), inorganic chemicals 23,503 (15,459), pharmaceutical products 14,241 (9,414), essential oils and perfumery 15,160 (10,886), fertilisers 15,563 (17,457), synthetic dyestuffs 5,505 (3,996), plastics and cellulose derivatives 3,354 (1,362).

Imports also Increased

Chemical imports to France increased from 35,300 million francs in 1950 to 56,200 million francs in 1951. This rise was proportionately larger than that in exports, but was in line with imports as a whole. Apart from her own overseas territories, Great Britain remains the principal buyer of French chemical products, although substantial tonnages are also exported to France's continental neighbours, as well as Holland and the Scandinavian countries. French exporters hope to develop further their trade with Mediterranean countries, of which Turkey and Egypt provide the largest markets for French chemicals. Outside Europe, the United States, Brazil and Argentina are big markets, and India also figures prominently in the French chemical export trade even though France's share in the big Indian market is comparatively small.

It is questionable whether the French export trade in essential oils, perfumery, soaps, pharmaceutical preparations and photographic films would have developed as favourably as it did last year if there were no special clearing arrangements within the European Payments Union and other countries had not pursued a trade liberalisation policy. Exports of some of the luxury items took a more favourable course than the trade in more essential products, which was hampered by shortages.

In the near future French chemical producers hope to export larger quantities of insecticides, detergents, chemical fibres and plastics—production of all of which is expected to increase as a result of investments in new factories and extensions in the petroleum chemicals field.

The supply position for basic chemicals seems to have improved recently and may permit larger shipments of the more traditional lines. From the foreign exchange point of view the French authorities particularly deplore the falling-off last year of phosphate exports.

Glass-Lined Plant in Hungary

HUNGARIAN Heavy Industries, a technical quarterly published in Budapest, V., Alkotmany-u.16, contains in its last number an article entitled 'Combat Corrosion with Glass-Lined Chemical Plant Equipment.' An efficient and reliable solution of the corrosion problem has been brought about in Hungary by the discovery that glass could be fused with cast iron and also steel. The development of this idea reached its present high level of efficiency only after many years of research, until a steel alloy ideally fusible with glass, special welding electrodes and enamels with a suitable heat expansion coefficient had been found. The components of the enamels vary according to service requirements, the basic materials being borax and silicates.

The richly illustrated article describes the glass-lined types of autoclaves, distilling plants, vacuum or pressure crystallisers, tanks, vessels and pumps and other apparatus for the chemical industry. The acid- and alkali-resistant glass lining covers all surfaces exposed to corrosive action of chemicals, and this protective coating does not etch and is said to show no cracks at high or low service temperatures.

Publications & Announcements

PUBLISHED by Shell Chemicals Ltd., in booklet form, is a recent lecture by R. N. Wheeler, B.A., A.R.I.C., manager, Products Development Department, on 'Some Contributions of the Petroleum Chemical Industry in the Surface Coatings Field'. It describes the growth of the petroleum chemical industry to its present position of supplying 5,000,000 tons (1950) of synthetic chemicals annually—approximately 50 per cent of the total world production of organic chemicals. It also deals with questions of sources of supply and outlines the methods for obtaining some of the most common organic substances in use in industry, as well as their subsequent uses. The lecture is reprinted from the *Journal of the Oil & Colour Chemists' Association*, **35**, No. 381, March, 1952).

* * *

CHEMICAL Safety Data Sheet SD-43, 'Acetaldehyde', has been issued by the Manufacturing Chemists' Association, Inc. This publication summarises the physical and chemical properties of acetaldehyde, points out its hazards and recommends precautionary measures. Emphasis is placed upon the caution which must be exercised in shipping and storage and comprehensive information is included on personal protective equipment for various parts of the body, with special emphasis on eye protection. The booklet contains detailed first aid instructions, as well as useful medical data supplied by the Medical Advisory Committee of the Manufacturing Chemists' Association, Inc. It may be purchased at 30 cents a copy from the Manufacturing Chemists' Association, Woodward Building, 15 & H Streets, Washington 5, D.C. Remittance should accompany order.

* * *

'WELDING Research', Vol. 5, No. 6, journal of the British Welding Research Association, is now available from the Association at 29 Park Crescent, London, W.1, price 5s. This issue covers the period, December, 1951, and includes a report on the A.C. Argonarc process for welding aluminium—an oscillographic analysis of the effects of welding transformer open-circuit voltage on re-ignition, and another on the spot welding of coated mild steel sheet.

CONTAMINATION of persons or of laboratory areas and equipment is a problem of fundamental importance to everyone working with radioactive isotopes. A new publication 'Control and Removal of Radioactive Contamination in Laboratories,' National Bureau of Standards Handbook 48 has recently been issued (Government Printing Office, Washington, D.C., 15 cents). In addition to general safety precautions, recommendations are included primarily for the guidance of users of radioactive isotopes in universities, hospitals and industrial concerns. The handbook discusses permissible levels of contamination as well as decontamination procedures for the skin, clothing and bedding, laboratory tools and glassware, floors, workbenches, hoods, and so on. Emergency procedures are also outlined.

* * *

THE importance of safety in chemical works is generally well appreciated in Great Britain, but it is a subject which cannot be too highly stressed. 'Plan to Live' a film on industrial chemical safety has been produced by Indiana University, U.S.A. The film is intended for research chemists, chemical production workers, laboratory supervisors, safety directors and students. Its purposes are stated to be: to stimulate personnel to use available safety equipment and to 'think safety' as an integral part of every plant job; better appreciation of the planning and thinking that is required to obtain safe working conditions as directed by management; and to emphasise the interdependence of all plant workers in developing and maintaining safe working practices in laboratory and plant. The educational authors were Dr. John S. Peake and Dr. Charles S. Rohrer, department of chemistry, Indiana University and selected sequences were photographed at the Eli Lilly Company, Indianapolis.

* * *

'USES of Copper Sulphate' is the title of a booklet published by the British Sulphate of Copper Association, Ltd., of 1 Great Cumberland Place, London, W.1. It describes the many uses to which copper sulphate is being put throughout the world in industry, agriculture and medicine.

Next Week's Events

MONDAY 24 MARCH

Royal Institute of Chemistry

Dartford: County Technical College, Lowfield Street, 7.30 p.m. Film display, including 'Atomic Physics'.

TUESDAY 25 MARCH

Institute of Metals

Swansea: University College, Singleton Park, 6.30 p.m. Annual general meeting of South Wales Local Section, followed by films of metallurgical interest.

Society of Instrument Technology, Ltd.

London: 26 Portland Place, W.1, 6.30 p.m. F. R. Axworthy (Everett Edgcumbe, Ltd.): 'The Design and Application of a Portable Electrostatic Watt Meter'.

WEDNESDAY 26 MARCH

Society of Chemical Industry

London: 11 Chandos Street, Cavendish Square, W.1, 6 p.m. Microbiology Group, annual general meeting, 6.15 p.m. Dr. P. F. Fraser: 'Wine Diseases and Condition Troubles; Their Prevention and Cure'.

Chemical Engineering Group (SCI)

Birmingham: University, Edmund Street, 6.30 p.m. Joint meeting with the Chemical Engineering Group and Birmingham Section, SCI. G. Noble: 'Construction and Personal Planning of the Esso Refinery, Fawley'.

Manchester Literary and Philosophical Society (Chemical Section)

Manchester: Portico Library, Mosley Street, 5.45 p.m. Dr. M. Barak (Chloride Batteries Ltd.): 'The Chemistry of the Lead/Acid Storage Battery'.

Royal Statistical Society

Birmingham: Chamber of Commerce, New Street, 6.45 p.m. Industrial Applications Section. J. Murdoch: 'Congestion Problems in Industry'.

THURSDAY 27 MARCH

The Chemical Society

London: Burlington House, Piccadilly, W.1, 7.30 p.m. Hugo Müller Lecture. Professor F. A. Paneth: 'The Chemical Exploration of the Stratosphere'.

Manchester: University. One-day symposium: 10 a.m. 'The Principles and Applications of Ion Exchange'. Joint meeting with the RIC, SCI and the Institute of Petroleum. An exhibition of apparatus and demonstrations of techniques will be on view from 12.30-8.30 p.m. in the Roscoe Library.

Institute of Metals

Birmingham: James Watt Memorial Institute, Great Charles Street, 7 p.m. Christopher Smith: 'Extrusion'.

The Royal Society

London: Burlington House, Piccadilly, W.1, 4,30 p.m. D. Gabor: 'Wave Theory of Plasmas'; G. C. McVittie: 'A Model Universe Admitting the Interchangeability of Stress and Mass'.

Society of Leather Trades' Chemists

Northampton: College of Technology, St. George's Avenue, 2.30 p.m. Dr. A. F. H. Ward: 'Recent Investigations and Applications of the Boundary Tensions of Solutions'.

Aslib

Sheffield: Central Library—full day conference. Morning session: 'Working of Three Types of Library'; Afternoon: 'Technical Information Services'.

FRIDAY 28 MARCH

The Chemical Society

Aberdeen: Marischal College, 7.30 p.m. Joint meeting with RIC and SCI. Dr. R. L. M. Synge: 'Chromatography'.

Institute of Metal Finishing

Sheffield: Grand Hotel, 6.30 p.m. Sheffield and North East Centre. E. A. Ollard: 'The Effect of Impurities in Plating Solutions'.

Institute of Fuel

Liverpool: Radiant House, Bold Street, 2.30 p.m. Annual general meeting. Dr. E. G. Ritchie (director, Steam Engineering Department, BCURA): 'Research into Steam and Heat Utilisation in Industry'.

Plastics Institute

Manchester: Engineers' Club, Albert Square, 6.45 p.m. J. Butler (B.I.P. Ltd., Oldbury): 'Practical Do's and Don'ts in Tool Design'.

SATURDAY 29 MARCH

Institution of Chemical Engineers

Manchester: Reynolds Hall, College of Technology, 3 p.m. T. Edmondson and Dr. M. Pearce: 'The Effect of Packing Size on the Absorption of Carbon Dioxide from Air with Caustic Soda Solutions'.

Tax on Hydrocarbon Oils

A STATEMENT regarding the further imposition of tax on their essential raw materials has been issued on behalf of the users of light hydrocarbon oils by the Industrial Light Oils Committee, London which represents 17 national trade associations.

The statement reads:—

'It is not generally appreciated that the duty on light hydrocarbon oils, commonly known as the petrol tax, is also paid by a wide range of industries using light oils in manufacturing processes. These industries which include—rubber, paint, printing ink, wallpaper, linoleum, food manufacture, dyeing and cleaning and others—have lodged a protest with the Chancellor of the Exchequer against the additional imposition of 7½d. per gallon tax on their essential raw materials.

'The industries affected had already lodged an appeal for the abatement of the existing tax and pending a decision on that appeal, they request that the additional 7½d. per gallon tax now imposed be immediately withdrawn.

'All the chief industrial countries in the world with the exception of the United Kingdom already grant relief to industries using light oils for manufacturing processes'.

Analysts' Officers Elected

SATISFACTORY progress and an active year were recorded in the report of its council submitted to the Society of Public Analysts and Other Analytical Chemists at its 78th annual general meeting held in London on Friday, 7 March.

Membership of the society had been increased by 16, and now totalled 1,578. In addition to its six ordinary meetings, there had been 16 meetings held by its sections and groups in the course of the year.

The financial statement and report were submitted and approved.

Officers and members of the council were elected as follows for the forthcoming year: *President*, Dr. J. R. Nicholls, C.B.E. *Past presidents serving on the Council*: Lewis Eynon, E. B. Hughes, G. W. Monier-Williams and George Taylor. *Vice-presidents*: R. C. Chirnside, D. W. Kent-Jones and Eric Voelcker. *Honorary treasurer*: J. H. Hamence. *Honorary secretary*: K. A. Williams. *Ordinary members of council*: C. A. Adams, D. C. M. Adamson, N. L. Allport, A. J. Amos, B. S. Cooper, N. Heron, T. McLachlan, H. E. Monk, G. H. Osborn, A. A. Smales, H. C. S. de Whalley and E. C. Wood. *Ex officio members*: A. A. D. Comrie (chairman of the North of England Section), H. C. Moir (chairman of the Scottish Section), C. L. Wilson (chairman of the Microchemistry Group), J. Haslam (chairman of the Physical Methods Group), and H. O. J. Collier (chairman of the Biological Methods Group).

At the conclusion of the meeting the Bernard Dyer Memorial Lecture was given by the Hon. Mr. Justice Lloyd-Jacob.

Market Reports

LONDON.—The movement on the home market remains steady as regards deliveries against contracts, and there has been little change in the demand for those products more or less in day-to-day request. In general, however, quieter conditions have been reported and there is much uncertainty concerning the prospects for export trade and the effect of the Australian import cuts. Prices are unchanged and steady.

Coal tar products are moving steadily against existing commitments whilst new business is on a smaller scale than of late.

MANCHESTER.—Traders' reports on conditions during the past week mostly agree that buying is less brisk than it was in the closing months of last year. The slackening has been mainly in pretty well all branches of the textile industry, though in one or two other sections new business of late has been quieter. On the whole, however, there is a substantial aggregate movement of supplies against contracts, with a fair amount of replacement buying on home-trade account. Export business has been fairly active. A slight improvement in the demand for fertiliser materials has been reported. In the tar products market, where some of the light distillates have been affected by the increased petrol tax, pressure for most lines has been maintained.

GLASGOW.—After a quiet beginning trade in general chemicals picked up considerably and the week closed on a very firm demand. Export has continued steady throughout the week.

Law & Company News

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Satisfactions

BRITISH THERMIT CO., LTD. (formerly BLACKWELL'S METALLURGICAL WORKS, LTD.), Liverpool. (M.S., 22/3/52). Satisfaction, 18 February, of debentures registered 1 June, 1907, to the extent of £3,000; also satisfaction, 18 February, of charge registered 9 September, 1909.

SOLARTRON LABORATORY INSTRUMENTS, LTD., Kingston-on-Thames. (M.S., 22/3/52). Satisfaction, 15 February, of series of debentures registered 6 April, 1949 (fully).

Increases of Capital

The following increases of capital have been announced:—ASTELL LABORATORY SERVICE CO., LTD., from £5,000 to £7,000; ROPLA LTD., from £100 to £500; COPELAND & JENKINS LTD., from £100,000 to £150,000. WILSON & JUBB (LEEDS) LTD., from £1,500 to £25,000; W. J. CRAVEN & CO., LTD., from £21,000 to £26,000.

New Registrations

Solvents Reclamation, Ltd.

Private company. (505,374). Capital £5,000. Distillers of solvents and other chemicals. Directors: J. B. Aldred and P. S. C. Aldred. Reg. office: Oakwood Chemical Works, Sandy Lane, Worksop.

Thomson, Skinner and Hamilton, Ltd.

Private company. (28,779). Capital £10,000. Chemical manufacturers and merchants, etc. First directors to be appointed by subscribers. Reg. office: 12 Cadogan Street, Glasgow.

Gyl Chemicals, Ltd.

Private company. (505,280). Capital £1,000. Manufacturers of chemicals. First directors are not named. Reg. office: National Buildings, Parsonage, Manchester 3.

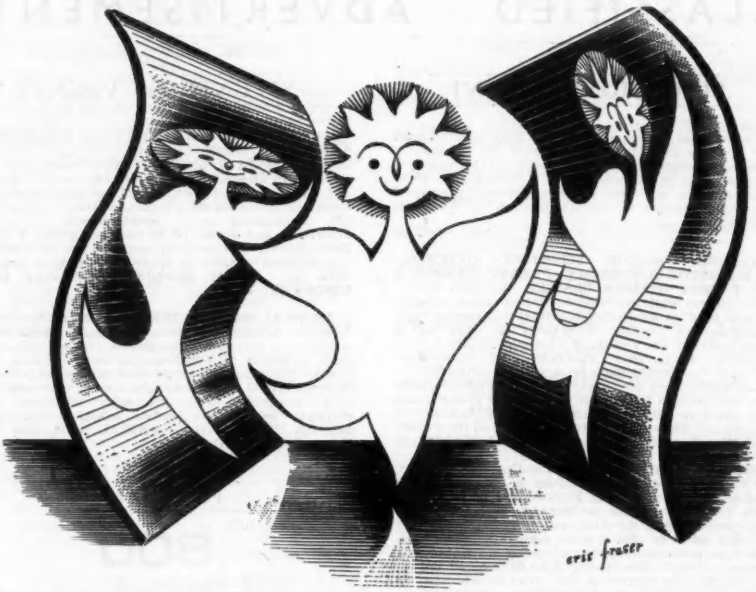
Company News

P. B. Cow and Co., Ltd.

A remarkable recovery is shown by P. B. Cow & Co., Ltd. (rubber and plastic manufacturers). The board is resuming ordinary dividend payments after a lapse of two years with a distribution of 15 per cent for 1951. Group profits for the period under review were £507,675 compared with £258,622 in 1950 and a loss of £114,000 in 1949.

Wm. Neill and Son (St. Helens), Ltd.

As a step towards bringing the issued shared capital more into line with the actual capital employed in the business, the directors of Wm. Neill and Son (St. Helens), Ltd. recommend that the sum of £50,000 from the general reserve be capitalised by paying up in full 50,000 ordinary shares of 2s. each for distribution among shareholders on the register on 21 March, on the basis of one share for every three then held. This will be considered at an extraordinary general meeting on Friday, 28 March.



'FLEXIBLE' IS MY MIDDLE NAME! says Mr. Therm

The gas and gas-heated equipment that Mr. Therm brings in his train are amazingly flexible in their applications to all sorts of heating problems. What other fuel but gas could give you a tiny—but steady—pin-point of flame or full heat the instant you want it? And gas can be controlled at the flick of a finger—or can be completely automatic if required. It needs no storage space, is smokeless and ash-free, and works unfailingly for you with remarkable efficiency. No wonder Mr. Therm is to be found hard at work in so many industries!

Mr. Therm is in the pink

. . . and in a lot of other colours, too! He's got the job of heating the battery of reaction vessels—each of 220 gallons capacity—used in the production of aniline dye at the works of Williams (Hounslow) Ltd. Town gas is used throughout for heating. The specially designed internally insulated housings hold cast-iron pans which are enamelled inside, and fitted with belt-driven agitating mechanism.

MR. THERM BURNS TO SERVE YOU THE GAS COUNCIL · 1 GROSVENOR PLACE · S W 1

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive, or a woman aged* 18-59 *inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order,* 1952.

AMENDED. SENIOR SCIENTIFIC OFFICERS; SCIENTIFIC OFFICERS; PATENT EXAMINER AND PATENT OFFICER CLASSES. The Civil Service Commissioners invite applications for permanent appointments to be filled by competitive interview during 1952. Interviews will continue throughout the year, but a closing date for the receipt of applications earlier than December, 1952, may eventually be announced. Successful candidates may be appointed immediately. The Scientific posts are in various Government Departments and cover a wide range of Scientific research and development in most of the major fields of fundamental and applied Science. The Patent posts are in the Patent Office (Board of Trade), Admiralty and Ministry of Supply.

Candidates must have obtained a University Degree with first- or second-class honours in an appropriate Scientific subject (including Engineering) or in Mathematics, or an equivalent qualification, or for Scientific posts, possess high professional attainments. Candidates for Senior Scientific Officer posts must in addition have had at least three years' post-graduate or other approved experience. Candidates for Scientific Officer and Patent posts taking their degrees in 1952 may be admitted to compete before the result of their degree examination is known.

Age Limits: Senior Scientific Officers, between 26 and 31; for Scientific Officers and Patent Classes, between 21 and 28 during 1952 (up to 31 for permanent members of the Experimental Officer Class competing as Scientific Officers).

London Salary Scales: Senior Scientific Officers (men), £812-£1,022; (women) £681-£917; Scientific Officers (men), £440-£707; (women) £440-£576; Patent Examiner and Patent Officer Classes (men), £440-£655. (Rates for women under review.) Somewhat lower rates in the provinces.

Further particulars from the **CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, TRINIDAD HOUSE, OLD BURLINGTON STREET, LONDON, W.1,** quoting No. 853/52 for Senior Scientific Officers and 852/52, S.128/52 for the other posts.
16045/120/WP.

THE DIVISION OF ATOMIC ENERGY (PRODUCTION), Risley, invites applications for **CHEMISTS** for work involving the flowsheeting of chemical processes from chemical and chemical engineering research and development data, and advising on details during the design of production plants.

Applicants must have either an Honours Degree in Chemistry, Chemical Engineering or Engineering, associateship or corporate membership of a corresponding Institute or Institution, or equivalent qualifications.

Post-graduate research and plant design experience would be an advantage.

For applicants who have had at least three years' experience in chemical plant development or operation, salary will be assessed according to qualifications and experience, within the range £927-£1,218 per annum. For others, it will be assessed according to qualifications and experience within the range £833-£927 per annum (if over 34) and according to age within the range £597 (at age 25)—£803 per annum (if under 34). There is a voluntary Superannuation Scheme. **APPLICATIONS to MINISTRY OF SUPPLY, D.At.En.(P.), RISLEY, Nr. WARRINGTON, LANCS.,** quoting reference 309.

SITUATIONS VACANT

A PROMINENT firm of **CHEMICAL ENGINEERS** in South West London have a vacancy in their laboratory for an **ASSISTANT CHEMIST.** Candidates must have a Degree in Chemistry and, preferably, be aged 25 to 30. The work is interesting and varied and offers considerable scope and prospects for a man of initiative and address. The commencing salary would depend on age and experience, but would not be less than £600 per annum. Profit-sharing and pension schemes are in operation. Appointment subject to Ministry of Labour approval. **BOX No. C. 4641, BENSONS, KINGSWAY HALL, KINGSWAY, W.C.2.**

CHEMICAL MANUFACTURERS in the Home Counties invite applications from Assistant Chemists for positions in Research Laboratories. Duties will include shift operation of experimental units (42-hour week basis). Preference will be given to candidates possessing Intermediate B.Sc., but applications will be considered from unqualified assistants with experience. The Company operates a Pension Scheme. Apply **BOX NO. C.A. 3125,** THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

FOR SALE

600

PROCESS PLANT

Kek No. 3 **BEATER MILL** with bin 3 ft. 8 in. diam. by 2 ft. 5 in. deep, tapering down to 2 discharge outlets 8 in. diam. Top and bottom serrated discs with beaters of manganese steel. Fitted ¾ in. perf. screen. Underdriven through worm wheel. Suitable for grinding and fibring wide range of materials, chemicals, foodstuffs, colours, etc.

Two 39 in. oscillating **HYDRO EXTRACTORS,** with rubber covered baskets 39 in. by 16½ in. deep. Three-point suspension, 4 in. outlet in monitor. Motorised 400/3/50.

Sweetland No. 12, lead-lined **FILTER CARCASE.** 12 ft. 2 in. long by 3 ft. diam., lead lining approx. 3/16 in. Connections for 36 leaves. Fitted spur and pinion op. quick closing device.

Two recessed plate type **FILTER PRESSES** by Manlove Alliott with 54 plates 36 in. sq. by 1 in. thick. Hand op. closing gear.

Unused **VERT. MIXER** by Brierley, Collier & Hartley, stainless steel lined pan 18 in. diam. by 10 in. deep. Jacketed, 15 lb. pressure. No outlet. Vert. S.S. spiral type agitator. F. and L. pulley drive.

Lead-lined M.S. **STORAGE TANK.** 35 ft. long by 9 ft. diam. Welded steel constr., lined 3/16 in./¼ in. lead sheet. Two 4-in. and one 3-in. fixed flange connections.

Three 10 Barrel " Proda Glas " vert. **TANKS.** 4 ft. 5 in. diam. by 4 ft. 9 in. deep of M.S. constr., with M.S. low pressure brine jacket and 6 in. cork lagging. almost new condition.

Two 4-cyl. **AMMONIA COMPRESSORS** by L. Sterne. Type 4W7. Each designed to develop 41 tons refrigeration at 410 r.p.m. Complete with condenser, oil separator, liquid receiver and centrifugal pump. " V " rope drive.

GEORGE COHEN SONS & CO., LTD.,
SUNBEAM RD., LONDON, N.W.10
Tel.: Elgar 7222 and
STANNINGLEY, Nr. LEEDS
Tel.: Pudsey 2241

FOR SALE

MORTON, SON & WARD LIMITED,
OFFER
the following

ONE—50 cu. ft. capacity M.S. Jacketed **"U"-shaped TROUGH MIXER,** with scroll type agitating gear arranged with motorised drive or fast and loose pulley.

ONE—new 24 cu ft. capacity "Morward" **TROUGH MIXER** with scroll type agitator, driven through reduction gear from direct coupled electric motor. Hand-wheel operated discharge door.

"Morward" **"U"-shaped TROUGH MIXERS,** made in sizes 16 to 100 cu. ft.

FOUR—Stainless Steel **MOTORISED AGITATORS,** direct coupled to 5 h.p. geared motors, 2-in. stainless steel shafts, 3-bladed propellers, 180 r.p.m. As new.

ONE—Stainless Steel Motorised **AGITATOR** by **MITCHELL,** 1 h.p., with adjustable shaft and two adjustable 2-bladed propellers.

TWO—200-gallon, Open-top **STAINLESS STEEL TANKS,** 20's gauge.

ONE—200-gallon all c.i. **JACKETED BOILING PAN,** arranged with mixing gear, driven through bevel gears from fast and loose pulley; c.i. fume-tight cover. Mounted on three legs.

A large selection of **VESSELS** in stock, which can be arranged with mixing gear and/or coil heating. Motorised or fast and loose pulley drive.

Numerous all bronze brass tube **CONDENSERS** and **HEAT EXCHANGERS** available, from 20 to 70 sq. ft. surface area.

HYDRO EXTRACTORS

72-in., 60-in., 48-in. and 30-in. by **BROADBENT** and 42 in. by **WATSON LAIDLAW,** all electrically driven, 3-point suspension, complete with starting equipment.

MORTON, SON & WARD LIMITED,
WALK MILL,
DOBCROSS, NR. OLDHAM
LANCS.
'Phone: Saddleworth 437.

CHARCOAL, ANIMAL AND VEGETABLE, horticultural, burning, filtering, disinfecting, medicinal-insulating; also lumps ground and granulated; established 1830; contractors to H.M. Government.—**THOS. HILL-JONES, LTD., "INVICTA" MILLS, BOW COMMON LANE, LONDON, E. TELEGRAMS: "HILL JONES, BOCHURCH, LONDON," TELPHONE 3285 EAST.**

GRAVITY Roller Conveyor several lengths, Rolls. 2½ in. diam. by 16 in. 3 in. centres. Good condition. **THOMPSON & SON (MILLWALL), LIMITED, CUBA STREET MILLWALL E.14.** (Tel. East 1844.)

MONOCHLORONAPHTHALENE (REFINED GRADE) IN 5-GALLON GALVANISED DRUMS. IMMEDIATE DELIVERY OF UP TO 42 TONS MUCH BELOW MARKET PRICE. Apply **BOX No. C.A. 3117,** THE CHEMICAL AGE 154, Fleet Street, London, E.C.4.

PHONE 96 STAINES

STAINLESS Steel Gas-heated Jacketed **MIXING PAN,** 22½ in. diam. by 36 in. deep (Enc.).

Stainless Steel Enclosed **ELECTRIC MIXER,** 16 in. diam. by 20 in. deep.

"Gardner" **POWDER MIXERS,** 5 ft. 6 in. by 2 ft. 4 in. and 5 ft. by 2 ft. by 2 ft.

Twin "Z"-blade **TIPPING MIXERS,** 43 in. by 40 in. by 28 in. and 16 in. by 16 in. by 14 in., 400/3/50.

Unused **CONDENSERS,** 325 ¾ in. diam. copper tubes, brass shell 3 ft. 6 in. by 5 in. diam. Ditto by "Weir," steel shell-brass tubes, 100 sq. ft. surface area. Many others by "Serck," etc.

HARRY H. GARDAM & CO., LTD., STAINES.

FOR SALE

VARIOUS MIXERS FOR SALE

FOURTEEN various open-top **STORAGE TANKS,** riveted, capacities from 300 gallons to 9,800 allons Last used for oil or varnish.

1¼, 2½ and 5½ size belt-driven DISINTEGRATORS by Christy & Norris or Harrison Carter.

Size No. 3 Junior Hammamac HAMMER MILL with fan and cyclone, also No. 1 size Miracle **GRINDING MILLS**

Robinson 3-sheet No. 1 size **CENTRIFUGAL DRESSING MACHINE** for dry powders etc.

Four ROTARY BOWL MIXERS, 5 ft. diam., cast iron built, inclined agitators, by Baker Perkins.

Kek GRINDING MILL, square pin type, with grinding discs 13 in. diam., including circular delivery bin with single outlet.

Large unjacketed WERNER MIXER, belt and gear driven, hand tipping, double "Z" arms, pans 31 in by 45 in by 36 in. deep.

No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER OR INCOPORATOR.** Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double "U"-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears, covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6 ft. by 4 ft. high to the to of the tipping screw.

No. 209 One **HORIZONTAL "U"-SHAPED MIXER,** steel built, riveted, measuring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. long by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

Two **FILTER PRESSES,** each fitted 68 wood recessed plates, 2 ft. 8 in. square, centre fed, with enclosed bottom corner delivery, cloth clips and belongings.

One **DEHNE FILTER PRESS,** cast iron built, fitted 45 recessed ribbed plates, 2 ft. 8 in. by 2 ft. 8 in. by 1¼ in., with bottom corner feed, cloth clips and bottom corner separate outlets, angle lever closing gear, etc.

SIMON HORIZONTAL TUBULAR STEAM HEATED DRIER, barrel with steam-heated tubes, 12 ft. long by 5 ft. diameter.

Further details and prices upon application

Write **RICHARD SIZER LIMITED, ENGINEERS, CUBER WORKS HULL**

SCREENLESS PULVERIZERS for fine grinding of Chemicals. Also **CYCLONES, ROTARY VALVE FEEDERS. Callow (Engrs.) Ltd. Kirkby Trading Est., Liverpool.**

SOLVENT WAX EXTRACTION PLANT, manufactured by Fraser & Fraser, £2,750 or near offer. Particulars, **BAKER & DAVIS, 58, THEOBALDS ROAD, LONDON, W.C.1.**

FOR SALE

TWO 35 ft. long by 9 ft. diam. Lead-lined **TANKS.** Stainless Steel **FILTER TANK,** 3 ft. 6 in. diam., and Jacketed **PAN,** 100 gallons.
Cast-iron **PIPES** and **FITTINGS,** 200 tons.
VALVES in Stainless, Gunmetal, Enamel Lined.
Free Catalogue, "**WATKINS MACHINERY RECORD,**" available.
FRED WATKINS, COLEFORD, GLOS.

1 Barron "**D**" **MIXER, TROUGH** 30 in. by 18 in by 18 in. Vee-belt drive to 2 H.P. motor, 750 revs. 400/3/50. As new.
One Werner Type **MIXER, TROUGH** 36 in. by 30 in. by 28 in. Twin "Z"-blades, power tilted, fast and loose pulley drive.
THOMPSON & SON (MILLWALL) LIMITED, CUBA STREET, MILLWALL, E.14. (Tel.: East 1844)

SERVICING

ALL CHEMICALS AND DYESTUFFS can be repacked for export by **The East London Chemical Warehouse Co., Buxton Street, Stepney, London, E.1.**

ATOMS AND MOLECULES. DOHMS reduce some materials to Atoms and Molecules. 14 factories for pulverising and refining industrial raw materials. **DOHM, LTD., 167, VICTORIA STREET S.W.1.**

CRUSHING, GRINDING, MIXING and DRYING for the trade.
THE CRACK PULVERISING MILLS, LTD.,
Plantation House,
Mincing Lane,
London, E.C.3.

GLASSBLOWING by **HALL DRYSDALE & CO. LTD., 58, COMMERCE ROAD, LONDON, N.22.** (Telephone: BOWes Park 7221.)

GRINDING of every description of chemical and other materials for the trade with improved mills. **THOS. HILL-JONES, LTD., "INVICTA" MILLS, BOW COMMON LANE, LONDON, E. TELEGRAMS: "HILL-JONES, BOCHURCH, LONDON," TELEPHONE: 3285 EAST.**

WANTED

PRECIOUS METAL RESIDUES, Precious Metals, Scrap Silver, and Mercury Amalgams, required for buying and processing. Apply **BOX NO. C.A. 3122,** THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

WASTE PICKLING LIQUOR WANTED, IN 5-TON LOTS OR MORE PER WEEK. OFFERS TO **BOX NO. C.A. 3126,** THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

HAND-OPERATED SACK LIFTER required in good working order, to lift 3-5 cwt. for a distance of 5 ft. or over. Details to **CRAYSOL, LTD., MANCHESTER, 11** Telephone: **EAS**t 2408/9.

WANTED

CHEMICALS FOR CANADA

AN Exporter with long standing experience and knowledge of Canadian market, going shortly to Canada. Serious offers, with possibility of meeting continuous orders, are invited from Manufacturers interested in introducing their products to, or enlarging their present sales in that market. Highest references available. Please write **BOX No. C.A. 3127, THE CHEMICAL AGE,** 154, Fleet Street, London, E.C.4.

PATENTS & TRADE MARKS

KING'S PATENT AGENCY, LTD. (B. T. King, A.M.I.Mech.E., Patent Agent), 146a, Queen Victoria Street, London, E.C.4. ADVICE Handbook, and Consultation free. Phone: City 6161.

WORKING NOTICES

PATENT No. 618949, for "**IMPROVEMENTS IN METHODS OF AND APPARATUS FOR HIGH VACUUM DISTILLATION.**" Owners desire to meet all demands for the utilisation of this Patent and invite inquiries from Manufacturers and others in Great Britain prepared to assist in its commercial exploitation. Address in first instance **MESSRS. POLLAK, MERCER & TENCH, CHARTERED PATENT AGENTS, 134, CHEAPSIDE, LONDON, E.C.2.**

THE Owners of **PATENT No. 591767** which concerns "**IMPROVEMENTS IN PREVENTION OF FOAMING OF HYDROCARBON OILS,**" are desirous of arranging by way of licence or otherwise, on reasonable terms, for the commercial development in Great Britain of this invention. For particulars address **ELKINGTON AND FIFE, 329, HIGH HOLBORN, LONDON, W.C.1.**

THE Proprietor of British Patent No. 567634, entitled "Improvements in or relating to Tubular Furnaces for Distilling or Cracking Processes," offers same for licence or otherwise, to ensure practical working in Great Britain. Inquiries to **SINGER, STERN & CARLBERG, 14, EAST JACKSON BOULEVARD, CHICAGO, 4, ILLINOIS, U.S.A.**

Printed in Great Britain by THE PRESS AT COOMBELANDS Ltd., Addlestone, and published by BENN BROTHERS LTD., at Bouverie House, 154, Fleet Street, E.C.4, 22 March, 1952. Registered at the General Post Office. Entered as Second Class Matter at the New York, U.S.A., Post Office.